

RAILWAY ENGINEERING

AND MAINTENANCE OF WAY.

WITH WHICH IS INCORPORATED
ROADMASTER AND FOREMAN

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Editorial--

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†Editorial.

*Illustrated.

Valuation.

THE subject of railway valuation is one which is attracting considerable attention, and one on which a large number of articles have recently been published. As in practically all subjects, many different ideas have been developed and exploited as to just how the real value should be obtained. A great many suggestions that have been made seem to lack practicability. Valuation is strictly an engineering function, and therefore railway valuation should be considered in the light of what is now considered real engineering.

Real engineering is common sense backed by technical knowledge and practical experience. A graduate of an engineering school may or may not be an engineer. He can usually be depended upon as a good surveyor, but unless he has had considerable experience, which he combines with good judgment, or in other words, with good common sense, he is not rightly called an engineer; his usual title, chainman, rodman, or instrument man, gives his status correctly.

Many of the engineers of greatest reputation pay little attention to details of what is termed strictly "engineering design." But through wide experience and observation these men have attained a faculty of locating inconsistencies which is truly remarkable. It is, however, merely the faculty of common sense developed to a degree where it might be termed "engineering sense."

Engineering sense is lost entirely when in railway valuation the statement is made that engineering is an imaginary item simply because its cost differs in various cases or localities. A board of unbiased engineers can "get together" and thrash out points on which they differ, and the final results of their combined efforts will usually work out to be fair to both sides. But of course it is impossible to lay down hard and fast rules for the cost of engineering on different jobs. The cost will vary with different conditions.

The same holds true of any engineering construction. In excavation, for example, it is impossible for the contractor to tell exactly what he will find under the surface. Test holes, experiences of others in the same location, etc., give valuable data, which however are not infallible indications of what local conditions may develop. Conditions of handling may make it more costly to move the material. However, in other places the material will be excavated and moved cheaper than estimated. Thus the law of average protects the contractor, provided, of course, that the contractor is capable, experienced, and makes careful estimates.

So it should work out with respect to the many varying conditions and costs finally arrived at in valuation. Values may be too high on certain territories or districts, but they will be balanced by low values at some other point.

Engineering charges, even what appear to be excessive charges, has been justifiable in much railway work. Other things being equal, a greater amount of money spent for engineering on a new road brings returns in reduced operating and maintenance expenses, which more than justifies what excess is paid for high talent or extensive investigation. And the economies affected by high cost of the engineering work, frequently cause the difference between a dividend paying or a non-dividend paying property.

"Spurring Out" Cars.

IN CONSTRUCTION work there is frequent necessity for temporary turnouts and crossovers, and there are few construction foremen who have not at one time or another found it necessary to make a turnout with no frog immediately available. The spread or number of the frog is generally of little importance in temporary work, so that any frog which will carry a train is usually considered all right for construction work.

Frequently a turnout or "spur out" must be made where there will be only one, or possibly two, movements over the turnout. It is of course not advisable in such a case to install a frog and switch points, it being less expensive to adopt some other means.

There are three general ways in which cars may be spurred out from a main or sidetrack, as follows: (1) Strip out the ballast between the ties, beginning at the joint where track is to be cut, and working back a couple of rail lengths, more or less, and line the track over; (2) use interlaced ties, lead rails, and a short piece of rail for a frog (as described in detail in Mr. Palm's article on another page of this issue); (3) pull the spikes out of the rails for some distance and line the rails over to connect with the temporary track (also described in detail following Mr. Palm's article).

The method described in (2) is a very efficient and handy one, and is a simple solution for a turnout when neither frog nor points are available. The use of such a switch has great possibilities in construction work.

Method (1), stripping out and lining the track over has been widely used. It is possible with this and method (3) to measure and lay out with sufficient accuracy the points where the joints will come, so that the necessary amount of temporary track may be laid before the main track is broken. This decreases the length of time it is necessary to flag the main track, and also frequently lessens the time the work train is detained. The objection that the roadbed is badly disturbed, is a sound one.

Method (3) does not disturb the roadbed and is the quickest way to spur out a few cars from a main line. The ties are not disturbed or moved from their beds at all, and the increased speed in the work is a great factor where there is heavy traffic.

Mr. Palm's method will undoubtedly be new to many, and is a very happy solution to the problem where a turnout is to be used only occasionally but often enough to make it objectionable to break and swing the track out. Such a turnout will also be of great help in the emergencies which frequently arise on construction work.

The Annual Inspection.

ON ANOTHER page of this issue R. Pottol, in a letter of unusual general interest to the railway officer, describes the evils of the annual official inspection, as an institution, in no uncertain terms. His exposition of the situation which is the natural result of the executive policy of annual inspections develops little or nothing unfamiliar to the railway officer who has worked himself up through the ranks and as a description of present evils, only, the letter would deserve less attention than it obtains due to the fact that the writer offers two remedies which are well worth careful consideration.

Mr. Pottol speaks of a clever railway executive, who has been gradually promoted through the ranks from the bottom, who is a firm believer in the system of annual inspections and adds

that, could this man "see some of the things that have taken place after the first underground message was sent out stating that the annual inspection would take place about such a time, he would make changes or modifications." There is no explanation, however, as to why this officer should not have seen these things while he was in the ranks.

It is in just such cases as this that the argument for the executive promoted from the ranks best obtains, and the conclusion to draw is that this executive, while cognizant of the situation mentioned, believes it, evil as it may be, better than any substitute plan which may have been presented. Certainly the policy of allowing the expenditure of time and money for the purpose of making a showing only, and during a short period of executive investigation, is one to be deprecated. An annual clean-up is, however, better than no clean-up at all.

The remedies offered are in brief: frequent *unheralded* inspections by the general manager himself, or continuous inspection in verification of the reports of subordinates by a responsible officer unknown along the line. On the large systems, the first remedy is perhaps properly considered impractical and the employment of inspectors offers the only alternative. On one of the larger systems where prizes are awarded for exceptional merit in maintenance, the data obtained from the reports of inspectors who are constantly at work counts most heavily in the prize distribution, the general manager's more or less superficial inspection being only supplementary. While there is, undoubtedly, some unavoidable unfairness to the men in this system, it seems to have been proven satisfactory in the average of years.

American Wood Preservers' Association.

THE REGULAR annual convention of the American Wood Preservers' Association will be held in St. Charles Hotel, New Orleans, January 20, 21 and 22.

This association is only ten years old, but has already enrolled a great percentage of those interested in wood preservation.

The ninth annual convention at Chicago in 1913 was very well attended and was the most successful in the history of the organization. The interest among the members promises a still better meeting at New Orleans.

The meeting will open at 10:00 a. m. January 20, and the morning will be taken up by addresses, secretary and treasurer's report, etc. Tuesday afternoon will be devoted to the report of the standing committee on Preservatives, together with various papers on the same subject.

During the remaining days, the reports of the standing committees on Wood Block Pavement, on Ties, Timbers, Piling and Cross Arms, and on Plant Operation, will be given and discussed, together with numerous papers on the above and allied subjects.

A deal whereby the Southern will come into possession of the Gulf, Florida & Alabama on the completion of the line to Pine Hill next September is under consideration between the officials of the two roads, it is said. The Southern is known to desire another outlet to the Gulf, preferably through Pensacola, by reason of the port's nearness to the Alabama mineral districts traversed by the Southern's lines.

It is said that railroad building in Texas is at a standstill, on account of the heavy rains which have fallen all over the state during the past thirty days. Construction of new mileage will continue to be hampered for some time on account of the heavy damage wrought by the recent floods.

Gardenville Classification Yard

The congestion in the West Seneca and East Buffalo yards necessitates additional facilities for handling the business of the New York Central Lines through the Buffalo district. The adopted Gardenville project when completed will not only fulfill these requirements, but also cut down operating expenses and eliminate delays in through as well as local business deliveries.

The approximate estimate of the project is:

Gardenville Yard, including viaducts.....	\$7,000,000.00
West Shore double-tracking and grade revision,	
West Shore, Erie, and D. L. & W. connections,	
and other incidentals	3,000,000.00
Total	\$10,000,000.00

The yard is projected for an ultimate capacity of 17,613 cars. It is located on the Terminal R. R. of Buffalo, which connects the Lake Shore & Michigan Southern Ry. and the New York Central & Hudson River R. R. Through freight is diverted over the Terminal R. R., and avoids entrance into Buffalo. The main line passes out around the new yard, and unimpeded operation is thus provided for through train movements.

At the north end, the Terminal R. R. has a wye connection with the N. Y. C. & H. R. R. R., and at the west, a wye connection is made with the L. S. & M. S. Ry.

The main features of the yard are those of a modern gravity classification yard, a succession of receiving, classification and advance yards, cars being moved always in the direction of their respective destination. The east bound and west bound yards are symmetrical with the axis of the general layout. The capacities are alike except the added features of an icing plant in the east bound yard. Two engine houses are to be located at the throat of the yard, one 30 and one 34 stall, equipped with depressed cinderpits.

The ruling grade is 0.25% (compensated for curvature) against east bound traffic. The hump approach in both directions is on a 1.0% grade. The momentum grade at the west bound hump is 200' of 4.0% grade, 200' of 1.5% grade and 1.13% grade through ladders and switches into the general classification yard. The momentum grade at the east bound hump is 200' of 3% grade, 200' of 1.5% grade and 1.0% grade through ladders and switches into the general classification yard. Cars are advanced over the humps and dropped by gravity into the classification yards. Cars from the classification yards are advanced over the drill tracks and made up into trains. Tonnage or symbol trains are made up in the advance yards. Incoming and outgoing road engine movements to and from engine house, are wholly separated, eliminating all fouling or crossing. The repair and transfer yards are located so as to insure the least amount of lost movement in advancing cars. No tests were made to determine proper hump and yard track grade percentages, these being based on experience at other similar yards.

Car Capacities.

Name of Yard	East-Bound	West-Bound	Total Car Capacity
Receiving Yard.	20 tracks@85-112 cars Ea. Total 1,910 cars.	20 tracks@92-115 cars Ea. Total 1,930 cars.	3,840
Classification Yd.	44 tracks@48-104 cars Ea. Total 3,078 cars.	44 tracks@48-104 cars Ea. Total 3,078 cars.	6,156
Transfer Yards.	8 tracks. Total 168 cars.	8 tracks. Total 168 cars.	336
Icing Yard.	8 tracks. Total 359 cars		359
Car Repair Yds.	11 tracks@21-23 cars Ea. Total 238 cars.	11 tracks@21-23 cars Ea. Total 234 cars.	472
Fuel Coal Yards.	Total 190 cars.	Total 190 cars.	380
Caboose Yards.	Total 65 cars.	Total 65 cars.	130
Tonnage Adv. Yd.	20 tracks@102-110 cars Ea. Total 2,100 cars.	20 tracks@105-110 cars Ea. Total 2,150 cars.	4,250
Symbol Adv. Yd.	10 tracks@62-85 cars Ea. Total 735.	10 tracks@65-85 cars Ea. Total 755 cars.	1,490
Miscellaneous.	100 cars.	100 cars.	200
Total.....	8,943	8,670	17,613

Engine Yard.

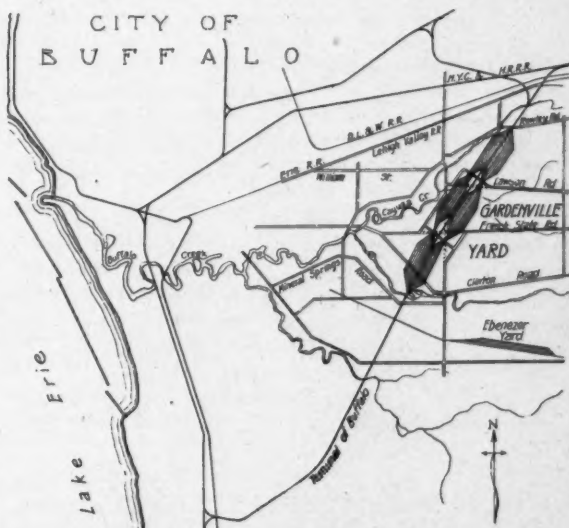
Name	East-Bound Eng. Cap.	West-Bound Eng. Cap.	Total Eng. Cap.
Engine House	64	64	128
Incoming Standing Tracks.....	21	21	42
Outgoing Standing Tracks....	14	14	28
	99	90	188

Highway Crossings.

Eleven highway grade crossings were eliminated by being carried over the yard on viaducts. French and Union roads were converged into one viaduct crossing over yard. These roads formerly intersected in the middle of the yard site, and the new arrangement makes it possible to carry both across on one viaduct. The latter was of course located at the narrowest point, or throat of the yard to shorten the viaduct, thus also decreasing the number of column supports it was necessary to place between the tracks. As shown on the plan, these roads were diverted and parallel the yard to the intersection with the common viaduct crossing. A similar plan was followed with Lawson road, which now crosses at a second throat of the yard, greatly lessening the length of the viaduct.

Structures.

The highway viaducts are of structural steel. The plan and elevation of the French and Union road viaduct is typical and is shown herewith. The column supports rest on masonry piers, the tops of which are even with the top of rail. The regular centers, 13 ft., do not afford sufficient clearance, so that it was necessary to locate the piers at points where the clearance was equal or greater than this, or to lay out the tracks with at



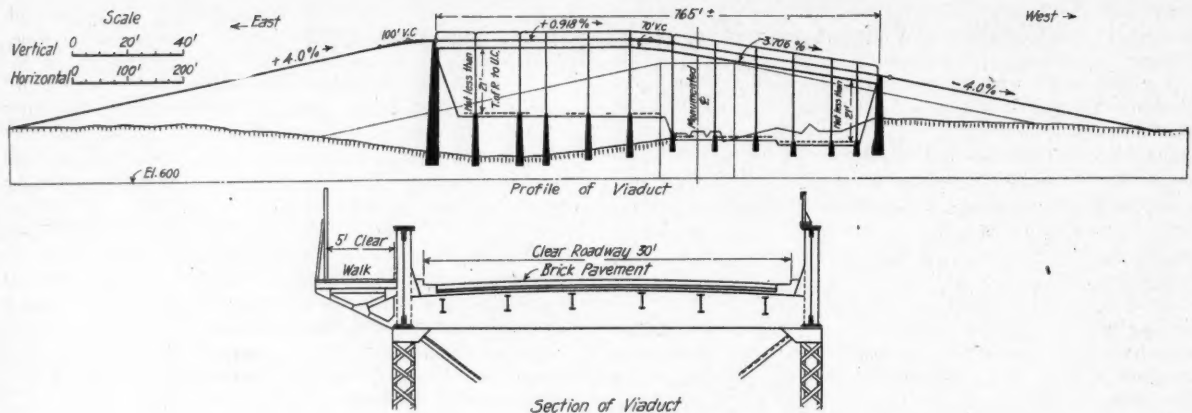
Territory Map Showing Location of Gardenville Yard.

least 16 feet centers, which is the minimum clearance used for the columns. For these reasons the spans are not of uniform length, and the piers are parallel to the tracks between which they are located.

The 4% incline has an eighteen ft. macadam roadway, which changes to brick pavement 30 ft. wide, a few feet from the bridge, or at the same point the grade changes. Approaching from the West, the grade eases down to +3.7% as it reaches the structure and near the center of the bridge this changes to a -0.918%, connected by a 70 ft. vertical curve. The approaches are on embankments with 1½ to 1 slope. The west side of the yard is considerably lower than the east, which accounts for the sharp approach incline reaching nearly to the center of the structure, and still giving the required minimum clearance of 21 ft.

The viaduct is a typical through girder type. The roadway is supported on longitudinal I-beams riveted to lateral floor beams. The latter are riveted to the longitudinal through girders, as shown in the section.

A sidewalk is provided on one side of the bridge. On the approach this sidewalk is macadam topped with screenings, and on the viaduct it is of concrete. The sidewalk is bracketed to



the outside of the girder. The girders and fence give ample protection to pedestrians. The through girder type is especially applicable here as it reduced the height of the structure and provides safety for teams which, even though frightened, can hardly get over the girders and assuredly cannot break them down.

The columns are channels latticed in pairs. They rest on pyramidal concrete bases carried down at least 5 ft. below the original ground surface, and where tracks are in excavation, the footings are 5 ft. below the top of rail. The abutments have dirt fills against their faces, forming buried abutments, thus balancing the pressure and making them of lighter design than would otherwise be necessary. The columns are braced by diagonal intersecting braces. The viaducts were designed to carry a surface railroad car weighing 50 tons loaded.

Track Layout.

Practically all of the yard tracks are on tangent, which is an exceedingly good feature and tends to cut down the maintenance cost materially. There is one small curve in the general alignment, and that occurs in the throat between the center and south yards, affecting comparatively few tracks.

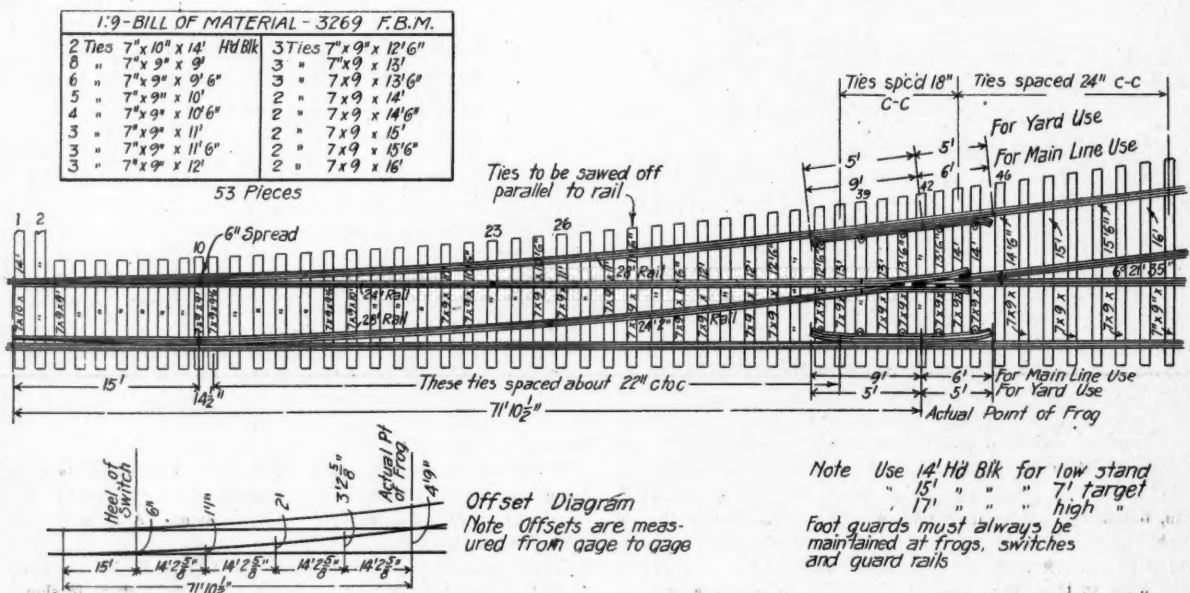
Track centers are 13 ft. for ordinary yard tracks, but these have been varied considerably throughout, to fit local conditions to be encountered in repair yards, etc. Some centers are as

high as 26 ft., and on the whole lots of room has been provided between tracks, which makes for safety and more efficient and satisfactory operation.

Three different size frogs are used: No. 8, No. 9 and No. 10. The majority of leads are No. 9, though there are a number laid with No. 8 frogs. In the past it has been the custom to use sharper curves and small number frogs; the use of the No. 9 is notable and this will also have a marked effect in reducing maintenance. Many yards can be observed, many built recently, where the leads have wide angle frogs and sharp curves, in spite of the fact that they lie in territory where right of way is cheap. On this site, plenty of room was available and good use was made of it.

The No. 9 ladders have been laid out, usually, with a sharper angle than the frog angle, and the curve is then continued back of the frog. This layout results in a shorter ladder, the only disadvantage being an additional length of curved track back of the frog.

The standard No. 9 turnout is shown herewith. This plan shows two standard guard rails. For main line the guard rail is 15 ft. long, the end located 9 ft. ahead of the point of frog. For yard work, a 10 ft. rail is used, with center opposite the frog point. These guard rails show five braces, without corresponding



Standard No. 9 Turnout, N. Y. C. & H. R. R. R.

braces against the track rail. The offset diagram is very useful to the foreman installing and lining the switch, and greatly reduces spike cutting the ties when lining leads.

The lead rails are 24 ft., 24 ft. 2 in. and two each 28 ft. long. Broken joints are maintained by placing the 24 ft. rails opposite the 28 ft. rails. The 24 ft. 2 in. rail is of course in the curved lead, which squares up the switch points.

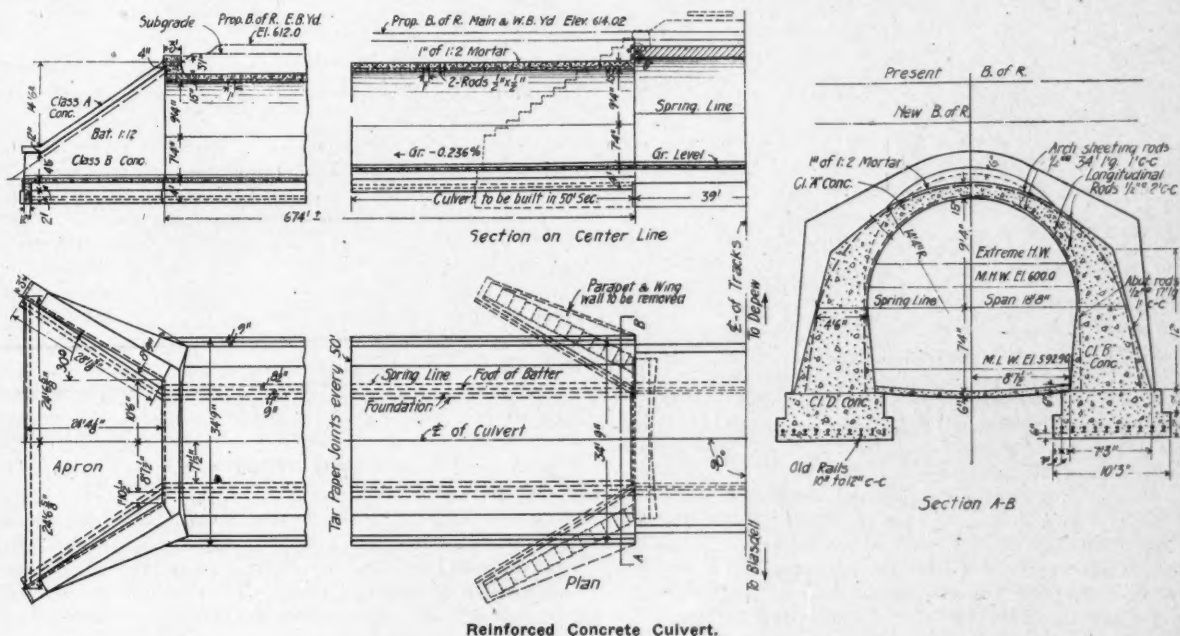
Drainage.

The drainage was worked out on the general plan which gives very complete data for this purpose. About every 1,000 ft. a cross-section of both the original ground line and the new sub grade is shown, which in addition to the track profiles, shows the conditions to be met in the yard proper. At the south end from station 290 to about 260, the yard is an embankment on comparatively level ground, and drainage is provided very simply by small lateral, wooden box drains, about $\frac{1}{2}$ sloping towards each side, at intervals of 100 ft. The tops of the sub grades

has been diverted into this culvert, which crosses the yard at right angles. The yard at this point is over 100 tracks wide, and necessitates a system of four longitudinal drains, one an open ditch, the others cast iron pipes of 14, 18, and 18 in. diameters. Besides these, there is the intercepting surface ditch on the north, all emptying into the concrete culvert.

The engine houses have an elaborate drainage system of 12 in. vitrified sewer pipe. These and yard drainage are carried east into a small stream, which also drains into the creek leading to the culvert. The yard is entirely on embankment at this point, station 180. Station 160 to 140 is in excavation, and two longitudinal ditches are located near the 3rd points in the yard, to take care of drainage from laterals, which are in general located every 500 ft. throughout the yard.

At station 135, a lateral 30 in. C. I. pipe carries yard and surface drainage into Cayuga creek, the track being on embankment. There is a short intercepting ditch on the south. The general



are level, the west-bound yards being several feet below the east-bound yards.

At station 260, there is a considerable slope in the original ground surface from south to north, and a 42 in. cast iron pipe carries this drainage under the yard. Lateral wooden box cross drains, 500 ft. centers, take care of the center of the yard drainage. The cross-section of the yard sub grade shows considerable fill toward the west. A second 42 in. C. I. pipe drain is carried under the yard at station 250, on the north side, but deflected a couple hundred feet on the north to intercept an open ditch parallel to the outside yard track. The open ditch is 4 ft. wide at bottom and has a 0.3% fall north. It follows outside the yard to station 230 where it crosses under six tracks and continues to station 215.

From station 240 east, the cross drains have a fall to the east, into the open ditch, or to the north in a ditch near the edge of the yard, but located between tracks. The latter ditch also drains into the 42 in. C. I. drain. This 42 in. drain, then, takes care of a part of the yard drainage, as well as the land drainage to the east of the yard.

Another similar open ditch starts at station 212, on the south side, but has a 0.5% fall to the south. Laterals drain into this ditch, and the latter drains into a 19 ft. concrete arch culvert. The ditch on the north side ends at station 204. The yard is very wide at this point, and lies in a cut, so the necessity for the large concrete culvert is evident. An old meandering creek

flow of the drainage, east to west, required a considerable amount of cross drains to carry the water from the land east of the yard, across to the lower ground on the west, and this required that these drains be of large capacity.

Concrete Culvert.

The reinforced concrete culvert, plan and section of which is shown, has a clear span of 18 ft. 8 in., a height of 16 ft. 8 in. at center, and a length of over 1,500 ft. The extrados has a radius of 14 ft. 4 in., and the intrados has a radius of 9 ft. 4 in. The thickness at crown is 15 in. The thickness at springing is 4 ft. 6 in. While the extradosal curve is not carried down to springing, the extradosal rods follow the curve, the thickness at springing being the same as if the extradosal curve were continued.

The extradosal and intradosal reinforcing rods, two inches from surface, consist of $\frac{1}{2}$ in. square rods 34 ft. long, spaced on one foot centers. Longitudinal rods are $\frac{1}{2}$ in. squares, on 2 ft. centers, in intradosal plane only. These were spliced to $\frac{1}{2}$ in. square rods 17 ft. long, extending to the footing.

The arch ring was poured in monolithic sections. Joints were forbidden, and after beginning to fill a form, workmen were required to stay until the form was completed. A layer of coal tar pitch $\frac{1}{8}$ in. thick was applied to the top of the culvert.

An old culvert which formerly carried the main lines, was made a part of the new culvert. The difference in section is shown in the drawing reproduced herewith, as is also the method of

binding the two structures together. The reason for decreasing the size of opening, is shown in the recorded depth of extreme high water, which leaves a very considerable factor of safety for the new culvert. The reduction in area amounted to a considerable saving in such a long structure.

Class A concrete, used in arch ring, is 1:2:4, with broken stone. No gravel was allowed in concrete above springing. Class B is 1:3:6 with gravel and Class D is 1:4:7½ with crushed stone. The arch ring had a 1 in. finish of 1:2 mortar.

Construction.

The grading amounts to 2,300,000 cu. yds. The filling was obtained from the yard site, cuts and fills being balanced. The material is loaded by steam shovels and graders into dump wagons and dump cars. The latter are unloaded from temporary tracks.

The program of construction was as follows: five eastbound receiving tracks, 25 eastbound classification tracks, five eastbound advance tracks, and some facilities for car repairs, all to be in service by the end of the year 1913. For 1914 there is proposed a corresponding westbound layout, five receiving, 25 classification, and five advance tracks, together with a 30 stall engine house with all facilities. Future developments will be contingent upon business requirements, and additions will be made from year to year as the needs of the service require.

We are indebted to Mr. George W. Kittredge, chief engineer of the New York Central Lines, for the data, plans, etc., from which this article was prepared.

RELINING CURVES.*

By F. J. Coates, assistant engineer.

The maintenance of track in proper line, both on curve and tangent, is one of the most important items of the work in the maintenance of way department.

Perfect track line is probably not known, but in order to realize the best service, constant effort is made to attain as nearly perfect line as possible. Tangents and curves should be placed in exact line and gauge. Careful gauging of track helps materially in the maintenance of line.

After a railroad is in operation, the center stakes soon become destroyed or misplaced and the effect of the traffic causes the track to shift more or less from the original location. This occurs both on curves and tangents and especially at the ends of the former.

For the easy movement of trains on curves, it is necessary that the irregularities be reduced or when possible, eliminated. It sometimes becomes necessary to replace the old curve with one of a slightly smaller radius in order to fit the existing conditions.

On our division it has been the practice for a number of years to spiral all curves over two degrees, and where speed limits are high, curves as low as one degree are spiraled. There is no material difference between the various transition curves as far as practical results are concerned, the only difference being in their pliability and the ease with which they can be inserted in the old track. Any form of spiral may be used that allows a definite offset at the P. C.

There are three ways in which room can be made for the offsets at the P. C.

First, by throwing the whole curve inward for the whole amount of the offset; second, by sharpening up the main curve; and third, by going back on the main curve a sufficient distance and there compounding to a curve whose radius is a trifle smaller than the main curve, care being taken that the second branch of the compound curve is not more than one degree greater than the main curve; however, this method should be used only when absolutely required in order to avoid relining bridges and widening the roadbed. If the roadbed will allow it and the curve is short, with no interference, such as bridges, it will be best to throw the whole curve the full amount of the offset in order to get a simple circular curve to replace the existing one.

* From the Illinois Central Magazine.

Where space is not limited, the length of the spiral should be made equal to the distance in which the superelevation is run off, using 60 feet of spiral for every inch of elevation on the main curve, and making the length of spiral dependent upon the degree of the curve and the speed; superelevations being the function of both these quantities. Transition curves enable the superelevation to rise uniformly as the curve increases and by the time it reaches the main curve, the full elevation is attained. Then the train passes from the tangent to curve, uniformly with the increased elevation.

In relining curves, there are a number of features to be kept in mind.

First, is the expense. Unnecessary throwing of the track means extra cost, and an attempt should be made to get a curve that will fit the existing track as closely as possible.

Second, is accuracy. On account of the many conditions and restrictions, such as narrow roadbed and bridges this class of work requires more careful consideration than in location or construction.

After the curve is run, it should be properly monumented. A piece of rail four or five feet long, set an inch or so above the ties, makes a very good monument. These monuments should not only be set at the end of the spiral and the circular curves, but at such additional points that all or any portion of the curve may be re-run at any time, thereby saving unnecessary labor and time to re-establish the points. The object of setting the monuments is two fold:

First, to enable the curve to be re-run at any time.

Second, to enable the section foreman to maintain a true location of the curve at all times, without the assistance of an engineering force.

Stakes should be set on the tangents for a distance of 600 to 800 feet, to allow the section force to properly line them to the curve.

ORES FOR STEEL RAILS.

Frank Ashley Wilmot, Engineer, Bridgeport, Conn., states that it is quite practicable to secure some increased hardness and consequent wearing qualities in steel rails (without special heat treatment of quenching and tempering and without sacrificing their toughness in the least but, on the contrary, increasing it in proportion to the increased stiffness) by the addition of iron ores such as come from the north of Cuba and some from Canada, which carry in the natural state some 1 per cent of nickel and 2 per cent of chromium without cost for these alloys.

By the use of a comparatively small portion of these ores in the making of the steel (say 25 per cent of the total Fe or iron charged) steel rails can be produced with something like one-quarter of 1 per cent of nickel and one-half of 1 per cent of chromium, with an increase of some 15 to 25 per cent in the strength of the steel in the untreated condition.

It is impossible to secure as cheaply such an analysis carrying chromium and nickel when such ores as carry these alloys are subjected to a Bessemer converter blowing treatment because of the readiness with which the chromium is oxidized.

In this all-basic-open-hearth furnace method (patented) of making real basic steel rails (the Bessemer process being entirely eliminated from any part of the operation) great possibilities are afforded for further improvement in the strength and life of the rails, thus insuring greater safety for the traveling public and further reduction in the cost of maintenance of track.

The San Benito & Rio Grande Valley is building an extension from Farnando to San Benito, Tex.

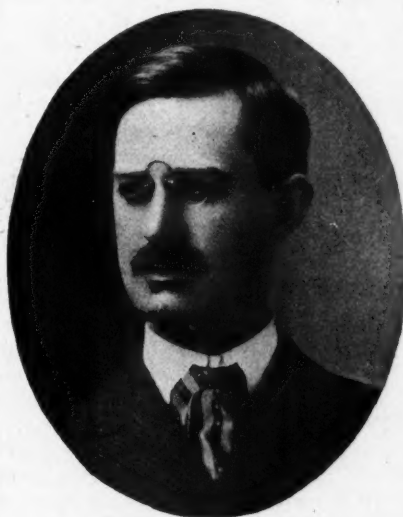
The Shelbyville, Petersburg & Decatur has been incorporated with a capital stock of \$10,000, and proposes a road from Shelbyville to Decatur, Ala.

Personals

Although we are publishing monthly in these columns a practically complete report of all appointments of interest to our readers, it is probable that this information could be published earlier if each subscriber would make it his business to notify us of new appointments immediately. We request and we shall appreciate your assistance in this respect.

J. E. NEWSON has been appointed superintendent of the *Albany Southern R. R.*, at Albany, N. Y., succeeding G. B. CHURCH.

H. D. FARLEY has been appointed superintendent of the *Artesian*



R. S. PARSONS, General Manager
Erie R. R.

Belt R. R., office at Macdona, Tex., succeeding M. D. JONES, resigned to engage in private business.

W. C. WEATHERS has been appointed superintendent of the *Branchville & Bowman R. R.*, office at Bowman, S. C.

C. F. MURPHY, formerly superintendent of transportation, has been appointed superintendent of the *Butte, Anaconda & Pacific R. R.*, office at Anaconda, Mont.

A. G. KING has been appointed superintendent of the *Canton R. R.*, office at Canton, Md.

As announced in the December issue of RAILWAY ENGINEERING, ELLIOTT E. NASH has been appointed assistant general superintendent of the *Chicago & North-Western Ry.*, office at Chicago. He entered railway service as station clerk on the C., St. P., M. & O. Ry., June 8, 1888, and held various clerkships, office boy to joint accountant clerk till March, 1891. He was traveling auditor from then till March, 1902, and agent till January, 1906, on which date he was appointed assistant superintendent. In May, 1910, he was assigned to special work in the president's office, and in May, 1911, was appointed superintendent of the C. & N. W. Ry., Minnesota division. He was transferred to the Madison division in April, 1912, where he held the position of superintendent till November 20, 1913, the date of his appointment as assistant general superintendent.

T. H. BEACOM, formerly assistant general manager, has been appointed general manager of the Third district, *Chicago, Rock Island & Pacific Ry.* at El Reno, Okla., succeeding C. W. JONES, appointed general manager of First district. Mr. JONES succeeds W. M. WHITENTON, resigned. F. J. EASLEY, formerly assistant general manager Third district, has been appointed assistant general manager First district, office at Des Moines, Ia., succeeding Mr. BEACOM.

B. C. BYERS has been appointed superintendent of the *Cleveland, Cincinnati, Chicago & St. Louis Ry.* at Mt. Carmel, Ill., succeeding P. J. MALONEY. J. A. MORRIS has been appointed superintendent at Cincinnati, O., succeeding E. H. ZIEGLER, transferred.

G. A. MORSON has been appointed general manager of the *Cuban Central Rys.*, office at Sagua La Grande, Cuba, succeeding HARRY USHER, appointed general manager of the *Buenos Ayres Pacific Ry.*

J. H. FRASER has been appointed superintendent of the *Detroit, Toledo & Ironton Ry.* at Springfield.

HENRY O. DUNKLE has been appointed general manager of lines west of Salamanca, *Erie R. R.*, at Chicago, Ill., also with jurisdiction as general manager. R. S. PARSONS, formerly assistant general manager, has been appointed general manager at Cleveland, O. J. B. DICKSON, formerly superintendent, has been appointed assistant general manager at Cleveland, O. F. B. LINCOLN has been appointed general superintendent at New York. W. A. BALDWIN, formerly superintendent, has been appointed assistant general superintendent at New York. C. P. ECKLES, formerly superintendent at Dunmore, has been appointed superintendent at Susquehanna, Pa., succeeding Mr. BALDWIN. A. C. ELSTON has been appointed superintendent at Jersey City, N. J., succeeding Mr. DICKSON. J. J. MANTELL, formerly trainmaster, has been appointed superintendent at Dunmore, Pa., succeeding Mr. ECKLES.

HENRY O. DUNKLE, general manager of the *Erie R. R.* at Chicago, was born at Pittsburgh, Pa., where he attended public school until about 14 years old. He then went to work in the Pennsylvania oil fields, where he learned telegraphy and later entered the service of the Baltimore & Ohio R. R. as night telegrapher. He was later appointed train dispatcher, and then accepted a similar position with the P. & W. R. R., where he was promoted to chief train dispatcher and then to trainmaster. He was appointed master of transportation of the South Carolina (now part of the Southern Ry.) and later entered the service of the B. & O. R. R. as trainmaster. He was next appointed superintendent of the P. & W. R. R. After several years he was appointed superintendent of the *Erie R. R.*, and in December, 1903, was promoted to general superintendent. His appointment as general manager was effective January 1.

T. G. BANKS has been appointed general superintendent of the *Houston & Brazos Valley Ry.*, office at Freeport, Tex. He was formerly superintendent, having previously been connected with the M., K. & T. Ry.

R. H. ENGLAND has been appointed general manager of the *Kanawha & West Virginia R. R.*, at Charleston, W. Va.

ARCHIE J. OREM has been appointed general superintendent of the *Nevada Copper Belt R. R.* at Ludwig, Nev.



H. D. FARLEY, Superintendent
Artesian Belt R. R.

F. R. BARTLES has been appointed superintendent of the *North-ern Pacific Ry.* at Dilworth, Minn. He succeeds T. F. LOWRY, appointed superintendent of the Minnesota division, office at Staples, Minn., vice A. J. SOVEREIGN, granted leave of absence after 35 years' continuous service. T. E. COYLE, formerly assistant superintendent, has been appointed superintendent at Pasco, Wash. He succeeds J. L. DE FORCE, appointed superintendent at Spokane, Wash., succeeding A. M. BURT, promoted.

JOHN G. SUTTON has been appointed vice president and general manager of the *Ocean Shore R. R.*, office at San Francisco, Cal.

FREDERICK MEARS, formerly chief engineer of the *Panama R. R.*, has been appointed general superintendent, succeeding J. D. PATTERSON, office at Colon, Panama.

JOSEPH H. GUMBES, formerly assistant superintendent, has been appointed superintendent of the Renova division, *Pennsylvania R. R.*, office at Renova, Pa., succeeding W. G. COUGHLIN, promoted.

T. J. HANLON, Jr., formerly superintendent, has been appointed manager of the *Pensacola Electric Co.* at Pensacola, Fla. J. G. HOLZCLAW has been appointed superintendent at Pensacola, succeeding Mr. HANLON.

E. H. ZEIGLER has been appointed superintendent of the *Peoria & Eastern Ry.*, office at Indianapolis, Ind., succeeding B. C. BYERS, transferred.



W. H. RUPP, Chief Engineer
Sumpter Valley Ry.

ROBERT LAWRENCE has been appointed general manager of the *Santa Fe, Raton & Eastern R. R.*, office at Raton, N. M., succeeding H. W. KRUSE.

F. E. PATTON has been appointed superintendent of the *Southern Ry. in Mississippi*, office at Columbus, Miss., succeeding M. J. WISE, promoted.

E. B. PENGRA has been appointed superintendent of the *Sumpter Valley Ry.* at Baker, Ore., succeeding C. H. FOX, now employed by the *Phoenix Iron Works*, Portland, Ore.

H. M. WAITS has been appointed general superintendent of the *Tampa & Jacksonville Ry.*, office at Gainesville, Fla., succeeding H. R. LORD.

The *Union R. R.* will occupy a new office building in East Pittsburgh early in January. Superintendent W. R. McFEATHERS' office will then be located at East Pittsburgh instead of at Port Perry, Pa.

E. F. HUNDLEY has been appointed superintendent of the *Vera Cruz Terminal Co.* at Mexico, D. F.

Engineering

E. L. LANDORPH has been appointed resident engineer of the Manitoba division of the *Canadian Pacific Ry.* at Winnipeg, Man.

He succeeds, C. G. WASHBON, appointed resident engineer at Brandon, Man., succeeding Mr. LANDORPH.

E. L. MEAD, formerly assistant engineer in the construction department, has been appointed assistant engineer in the district engineer's office of the *Chicago, Milwaukee & St. Paul Ry.* at Chicago. He succeeds JAMES ERSKINE, resigned.

L. S. ROSE, formerly signal engineer, has been appointed engineer in charge of valuation of the *Cleveland, Cincinnati, Chicago & St. Louis Ry.*, office at Cincinnati, O.

H. S. STANSBURY, formerly assistant engineer, has been appointed resident engineer of the *El Paso & South Western System*, office at Tucumcari, N. M., succeeding F. T. BECKETT. JOHN F. RIGHTMIRE has been appointed assistant engineer at Tucumcari, N. M., succeeding Mr. STANSBURY.

J. H. GOOS, rail inspector, has had his title changed to inspecting engineer, *Great Northern Ry.*, office at St. Paul, Minn.

As announced in the December issue of *RAILWAY ENGINEERING*, M. B. MORGAN has been appointed assistant engineer in charge of maintenance of way, *Illinois Central R. R.*, office at Chicago. He was engaged in construction work on this road from August, 1898, to May, 1911, on which date he was appointed assistant roadmaster. In May, 1912, he was appointed roadmaster of the Tennessee division, holding the latter position till November 17, the date of his appointment as assistant engineer at Chicago.

JOCELYN J. RICHARDSON has been appointed assistant engineer of the *Intercolonial Ry.* at Moncton, N. B. Previous to March, 1902, he was engaged in mining work, but on that date he entered the service of the *Pennsylvania R. R.* in the maintenance of way department. He left the service of the latter road in 1910 to accept the position of engineer for a manufacturing company. His appointment as assistant engineer was effective December 1.

As announced in the December issue of *RAILWAY ENGINEERING*, C. L. WALLACE has been appointed assistant chief engineer of the *Kansas City Southern Ry.*, office at Kansas City, Mo. He was born in Indiana and graduated from Purdue in 1903. He entered railway work as rodman in May, 1903, on the *Big Four Ry.*, and in December, 1903, went with the *Southern Pacific Co.* as transitman. In May, 1904, he accepted the position of assistant engineer with S. F. COLEMAN, consulting engineer at New Orleans. In 1904 and 1905 he was assistant engineer on location and resident engineer on construction of the *New Orleans Great Northern R. R.*, and in 1905 and 1906 he was superintendent in charge of bridge work and steam shovel work for Oliver Bros., on railway construction. December, 1906, to March, 1911, he was assistant engineer on the *St. Louis & San Francisco R. R.*, on special work, consisting principally of design and construction of terminals. In March, 1911, he was appointed office engineer on the *Kansas City Southern Ry.* His appointment as assistant chief engineer was effective November 15.

W. D. HUDSON has been appointed assistant engineer of the *Missouri Pacific Ry.* at St. Louis, Mo.

J. M. SULLIVAN, Jr., assistant engineer in charge of construction, *New York, New Haven & Hartford R. R.*, has moved his office from Harlem River to 29 North avenue, New Rochelle, N. Y., his territory remaining unchanged.

E. W. ZELLER has been appointed supervisor of construction of the *Norfolk & Western Ry.* at Roanoke, Va.

A. M. BURT has been appointed chief engineer maintenance of way of the *Northern Pacific Ry.*, office at St. Paul, Minn. He was born May 1, 1866, at Syracuse, N. Y., and educated in the common and college preparatory schools of New York and Massachusetts. He entered railway service in March, 1885, and served in various capacities from rodman to assistant engineer on the *Colorado Midland*, *Northern Pacific*, *Adirondack & St. Lawrence*, and the *Chicago & North Western Ry.* From January 1, 1897, to March 1, 1902, he was supervisor of bridges and buildings on the *N. P. Ry.*, and then to October 10, 1903, assistant superintendent at Grand Forks, N. D. On the latter date he was appointed superintendent, and was located successively at James-

town, N. D., Fargo, N. D., Missoula, Mont., and Spokane, Wash., until January 1, the date of his appointment as chief engineer maintenance of way.

R. G. FORD has been appointed transitman in the office of the engineer maintenance of way, *Pennsylvania R. R.*, at Philadelphia, Pa.

F. L. BURCKHALTER, district engineer of the Southern Pacific Co. at Portland, Ore., has been appointed, also chief engineer of the *Portland, Eugene & Eastern Ry.*

J. F. CRICKSHANK has been appointed superintendent of scales of the *Southern Ry.*, office at Washington, D. C. He entered railway service in 1896 as journeyman machinist, resigning in 1900 to go with the Streeter-Amet Weighing & Recording Co. as inspector in Southern territory. In 1912 he represented the company in several Interstate Commerce Commission hearings on the matter of weighing carload shipments of freight. He was appointed superintendent of scales, *Southern Ry.*, December 1, succeeding D. H. BEATTY, assigned to other duties.

J. I. LEE, formerly an assistant engineer of the *Southern Ry.*, has been given the title of office engineer; his duties, however, remain unchanged, office at Greensboro, N. C. He entered the service of this road upon graduation in 1900, as axman, and was promoted to rodman and then draftsman in 1901. In 1902 he was advanced to assistant engineer. From May, 1911, to December, 1912, he was employed in the chief engineer's office, and was then transferred to Greensboro, N. C., his present location.

H. E. TYRREL, formerly assistant engineer of the *Southern Ry.*, has had his title changed to office engineer, his office remaining at Washington, N. C., without change of duties. He has been with the *Southern* for the last eight years. F. S. WHITMAN has been appointed assistant engineer at Washington, D. C. P. L. THOMPSON has been appointed junior engineer at Greensboro, N. C.

As announced in the December issue of RAILWAY ENGINEERING, WARD H. RUPP has been appointed chief engineer of the *Sumpter Valley Ry.* at Baker, Ore. He was born June 1, 1883. His family moved to Monmouth, Ill., where he attended school and college. He was appointed to a position in the engineering department of the Illinois Central R. R. August 1, 1901, at Fulton, Ky., as track apprentice, and was advanced through the grades of chainman, rodman, instrument man and assistant engineer. He resigned June 13, 1907, as assistant engineer Peoria division, at Mattoon, Ill., to accept a position with M. P. Ry. at St. Louis, in office of engineer of maintenance of way, which position he resigned in November, 1907. In October, 1908, he accepted a position as engineer for the United Sugar Co. in Mexico. He went to Frisco in May, 1908, and accepted a position as assistant engineer in the office of district engineer of the Southern Pacific Co., in charge of special terminal work. September 1, 1912, he went to Portland, Ore., as draftsman in office of R. T. GUPPY, chief engineer of the Portland, Eugene & Eastern Ry., in charge of right of way, and was promoted on March 1, 1913, to position of chief draftsman, which position he resigned October 29 to accept the position of chief engineer noted above.

GEORGE P. TURNER has been appointed assistant engineer in charge of valuation of the *Union Pacific R. R.*, office at Omaha, Neb., succeeding H. BORTON, resigned.

Bridges and Buildings.

J. E. BUCKLEY, formerly general foreman, has been appointed supervisor of bridges and buildings of the *Boston & Maine R. R.* at Nashua, N. H., succeeding F. C. RAND, retired.

J. C. BROWN has been appointed general foreman of bridges and buildings, *Delaware & Hudson Co.*, at Whitehall, N. Y. He succeeds WM. POWERS (present address Rimersburg, Pa.), who has been pensioned after being in the employ of this railroad for 42 years.

H. A. DURKEE has been appointed supervisor of bridges and buildings of the *Oregon-Washington R. R. & Navigation Co.* at North Yakima, Wash.

Twenty Years Ago This Month

(From the Files.)

A. T. Sabin has been appointed engineer maintenance of way of the Chesapeake & Ohio South Western.

The Bellefontaine bridge across the Missouri River was tested by the first train on December 27th. The bridge will be ready for traffic this month.

The cause of the Louisville and Jeffersonville bridge disaster the 15th of last month was attributed to the negligence of the Phoenix Bridge Co., builders. This bridge fell during construction, carrying with it fifty workmen, twenty-one of whom were killed.

A 36-lever interlocking plant was built by the National Switch & Signal Co. for the junction of the Lake Shore & Michigan Southern; the Cleveland, Cincinnati, Chicago & St. Louis; the Lake Erie & Western; and the Sandusky & Columbus Short Line; at Columbus, O.

The Leavenworth bridge across the Missouri River was opened for traffic Jan. 2.

A bill for allowing the construction of a bridge across the Hudson from the Manhattan to the New Jersey shores was introduced in Congress. The plan is to allow all railways to use the bridge on equal terms.

A pneumatic tube service connecting the City Hall, police stations, telegraph offices and newspaper offices in Chicago, has been built. The conduits are in nests of 29 and are made of vitrified clay pipes square on the outside and lined with 2 7/8 inch seamless brass tubing. The carriers are operated by exhausting the air ahead of them.

A disastrous rear end collision on the Delaware, Lackawanna & Western Jan. 15, has resulted in agitation for block signals by the public press. The New York Central is already equipped with block signals from New York to Buffalo.

Three new tracks were recently laid in the Grand Central terminal, New York. These tracks were built for the purpose of reaching the new freight house of the Adams Express Co. One of the tracks is laid with a curve of 75-ft radius and the others have 80-ft. radii. Chief Engineer Katte states that no difficulty is experienced in getting switching engines over the tracks.

Work on the Turchino tunnel, on the railway from Genoa through the Maritime Alps to Asti, is progressing at the rate of 9 ft, 6 in. per day. This tunnel will be four miles long and must be drilled through solid rock.

The new engineering laboratory at Purdue University was dedicated Jan. 19. It was destroyed by fire four days later.

The Meskill & Columbia River laid track during 1913 on the section from Mays to Hope creek, 2.5 miles, and surveys are being made from Hope creek to Grays river, 14 miles. J. C. Dolphin, Meskill, Wash., is secretary.

Surveys have been made by the North Railway, A. T. Tomlinson, 95 McGill St., Montreal, Que., for a 600-mile line from Montreal to Port Nottaway, James Bay. Contract for construction will be let shortly.

It is said that a railroad which will considerably shorten the haul between the Kentucky coal fields and Baltimore, Md., is being projected by a party of capitalists, including John T. McGraw, of Grafton, W. Va.

Plans are being made by residents of Grove, Okla., to organize a company for the purpose of building a railroad from Grove to Copeland.

The St. Joseph Valley in addition to the extension completed from Angola, Ind., to Berlein, has extended grading work from Berlein, east, 4 miles. The construction work is being done by the company's forces.

The Seaboard Air Line contemplates extending the line of the old Tampa Northern from Brooksville, Fla., to Inverness.

The Saluda-Hendersonville Interurban has been organized in

CONCRETE



DEPARTMENT

Spouting Concrete Into Place.

DURING the past few years many devices have been evolved to reduce the cost of placing concrete, that is, transporting it from the mixer to the forms. Of such devices the method of placing by spouting or gravity chute has become the most popular. Where the work is so arranged as to allow of a central mixing plant permanently located, from which the concrete is elevated to the top of a tower, then discharged into the conveying system and deposited at any desired point, the cost of placing can be reduced to a minimum. However, as is the case with all such seemingly perfect contrivances there is a drawback; in this case, that of an excess of water in the concrete being necessary in order to insure proper flow, unless the conveying system is very carefully designed.

A great deal of "laitance" (decomposed cement formed in the presence of an excess of water) forms on the surface of concrete which contains an excess of water, and this by no means strengthens the concrete. When fresh concrete is placed on concrete covered with such laitance the bond between the two sections is of very little value and construction joints are therefore sure to be very pronounced.

Improper mixing will not give good results when a gravity spouting system is used, proper mixing being the secret of success in all cases where the slopes of the chutes are correct. The mixture should be of such a nature as to have the stone held in suspension, the consistency being that of a thick gravy with no excess of water. Such a mixture is surprisingly slippery, with a sort of oily smoothness, and flows very readily. The man at the mixer can tell whether the mixture is of the right consistency by the following indications: If the concrete when dumped in the skip or hoisting bucket stands up, it is too thick; if it levels off and shows a covering of water, it is too thin. After the mixture is right much depends on having a continuous and steady flow of concrete in the chute. Where sharp angles occur in the conveyor a man should be stationed to prevent blocking up the chute or an overflow.

The fact that the easiest and quickest way to get concrete moving in the chutes after they have become clogged is to deluge the same with water has led the men on the job to realize that an excess of water at all times will prevent clogging and then naturally follow the path of least resistance. Only the strictest superintendence on the part of the contractor and the engineer in charge can prevent this abuse. It will sooner or later no doubt be found that concrete containing an excess of water is weakened considerably, and if contractors do not wish to have a ban placed on gravity conveyor systems they will do well to instruct their men that concrete without an excess of water, if properly mixed, will readily pass through the conveyor system.

Work has been started on the Tower Grove Viaduct at St. Louis, a structure which is to cost about \$600,000. This viaduct will cross the Missouri Pacific and the St. Louis & San Francisco Railroad. The railroads will pay the cost of the structure and the city all damages.

Reinforced Concrete in Temporary Construction

The description of the design and construction of temporary reinforced concrete towers to support the timber falsework for the construction of the great arch span of the Langwies viaduct, on another page in this issue, should prove of more than passing interest to the American engineer.

In this particular case the reinforced concrete towers were used to support the falsework on account of the danger of floods carrying away timber falsework which would have covered the entire valley, and on account of the difficulty securing good foundation and the desire to avoid excessive settlement in the falsework. Many times conditions nearly the same as these have had to be met in this country where large arches are built, yet we have no record of the use of a similar method of falsework construction. The question then arises as to whether our construction methods are as economical as they are generally considered. It requires little computation to find that the design used in the case under discussion was much cheaper than a design consisting entirely of timber falsework, when all conditions are considered.

The possibilities of the use of reinforced concrete for temporary construction are unlimited and with the decreasing timber supply in mind it is safe to say that before many years have past we will have similar excellent examples of the economical use of reinforced concrete as a temporary construction, or in other words, simply a means of attaining a certain desired end.

HOPPLE STREET VIADUCT, CINCINNATI, OHIO.

The Hopple street viaduct at Cincinnati, Ohio, on which bids have just been taken will be a reinforced concrete structure 1,930 ft. long, consisting of arched cantilever girders supported on piers with spans of 70, 75 and 80 ft. The roadway will be of beam and slab construction with part of the sidewalk cantilevered out from the outer girders. The viaduct will be 60 ft. wide with a 40 ft. roadway. The estimated amount of concrete required is 21,800 cu. yds., besides this 43,000 lineal ft. of concrete piling will be used. This viaduct will be located on the present site of Hopple street and will eliminate grade crossings with the Baltimore & Ohio Southwestern R. R. and the C., H. & D. R. R.

MOVING A REINFORCED CONCRETE BUILDING.

In April, 1912, a few days after the completion of a five-story and basement reinforced concrete hotel building 50 x 100 ft. in play, condemnation proceedings were brought against the owners by the city of San Francisco for a part of the civic center. After obtaining title the city had a strenuous time for about a year trying to get some one to take the building out of its hands. The job was finally done by Robert Bruce, who was given the building, besides a bonus of \$1,750 for moving the same.

The walls were cut off at street level and the entire building raised upon blocks and rollers and taken to a new site about one-quarter mile away. This structure weighing about 1,560 tons, is the largest reinforced concrete building ever moved.

A WASH FOR CONCRETE SURFACES.

To obtain a white concrete surface a wash of the following proportions has been successfully used by the Carnegie Steel Co., at New Castle, Pa.:

1 lb. concentrated lye; 4 lbs. alum; 5 gals. water.

To this sufficient cement was added to make a wash that would spread easily with a large brush.

Ludlow Avenue Viaduct, Cincinnati, Ohio

A Combination of Reinforced Concrete and Steel Girder Spans and Arch Spans—An Artistic and Pleasing Solution of a Grade Elimination Problem Involving Heavy Approach Grades.

By A. M. Wolf, C. E.

General.

At the present time the city of Cincinnati has completed and has under construction several concrete viaducts which are part of a program of grade crossing elimination adopted some years ago. Among the largest of these structures is the Ludlow Avenue Viaduct, now nearing completion. This structure is of special interest on account of the combination of three different types of construction in such a way as to have a finished viaduct of artistic appearance.

The building of this viaduct eliminates a grade crossing with the Baltimore and Ohio Southwestern Railroad Company's tracks, which has always been considered very dangerous on account of a sharp curve in a deep cut preventing a clear view of approaching trains. The traffic at this point is quite heavy, since trains of the New York Central Lines are also operating over the same tracks. For these reasons an overhead street crossing was especially desirable.

As will be seen on the location plan of the viaduct (Figure 1), the new route selected for the street is much more direct than the old and considerable curvature is eliminated. The old location will be abandoned. To provide sufficient waterway, arch spans were used over the stream.

The viaduct proper is about 1,336 ft. long, this length, however, is increased to about 1,500 ft. by earth fill approaches about 100 ft. long at each end, the north approach fill being retained

viaduct proper, a grade of 5 per cent is maintained for 368 ft. over the arch spans, for a distance of 586 ft. is a 4.65 per cent grade, the portion (174 ft.) over the plate girder span is level, the remainder (330 ft.) is on a descending grade of 0.25 per cent toward the south. The clearance over the railroad tracks is 22 ft.

Esthetic Considerations.

The general architectural treatment of the viaduct is very pleasing and artistic in spite of the heavy grades on the structure and the combination of arch and beam and girder spans. This is made possible by the symmetry of the structure as a whole and the fine proportion and balance of all parts. By carrying out the same spandrel detail on the fascia beams of the approach spans as is used on the arch spans an appearance of uniformity is obtained which greatly enhances the beauty of the structure. The use of false spandrel arches revealed on the fascia beams in order to make them more in harmony with the arch spans and eliminate the monotony of plain surfaces presented by the beams is somewhat unprecedented and not strictly in accordance with esthetic principles; however, the results certainly warrant the departure. The artistic design of a structure such as this, where the same type of construction cannot be used throughout on account of foundations in height, is much more difficult than for one where the conditions are more nearly uniform. The structure here described can be cited as a happy combination of economical structural and esthetic design.

Cost.

The total cost will be about \$350,000, of which \$70,000 was required for real estate and the balance, \$280,000, for the actual construction. Of this total cost the railroad company pays 65 per cent and the city of Cincinnati the remaining 35 per cent. The Cincinnati Traction Company, which will use the viaduct, will pay a certain portion of the city's 35 per cent.

Designing Loads.

Live Loads—The live load used for approaches, roadway over arches and span over railroad was for a 50-ton street car, 50 ft.

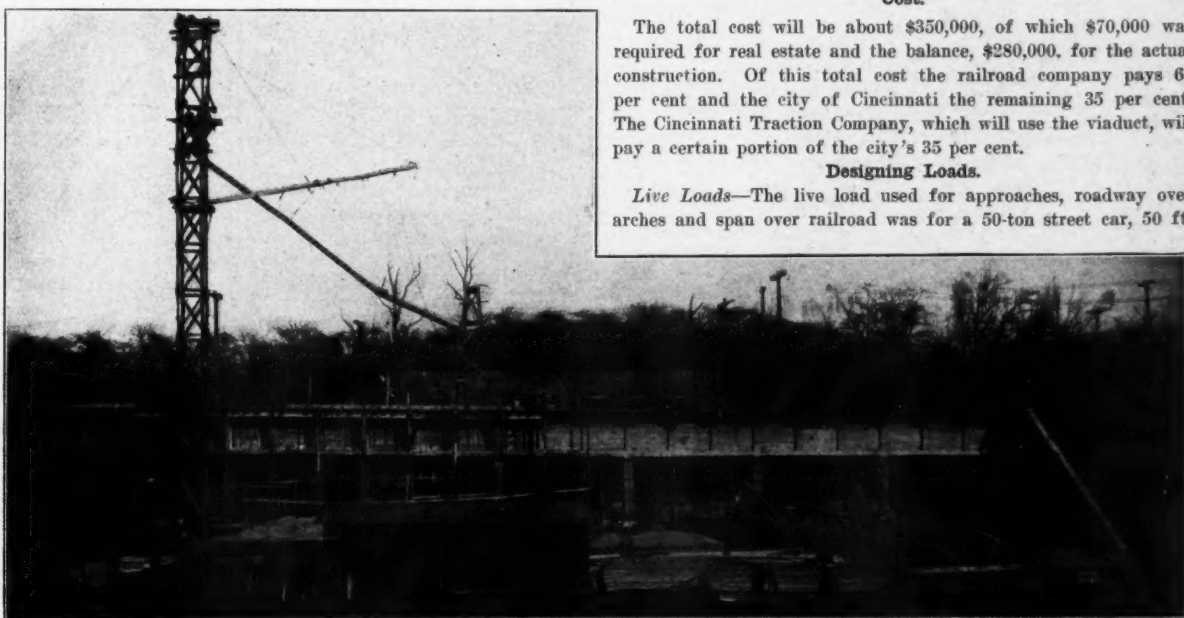


Figure 2-A. Beam and Girder Approach Spans—Ludlow Ave. Viaduct.

by concrete retaining walls. The structure is 60 ft. wide, with a 40 ft. roadway and two 10 ft. sidewalks. The entire viaduct, with the exception of the 110 ft. steel plate girder span over the railroad tracks, is of reinforced concrete, while the plate girder span is entirely encased in concrete. A length of about 600 ft. at the middle of the structure over Mill Creek consists of six solid barrel arches of 85 ft. clear span. The approaches at either end consist of cross girders carried on rows of reinforced concrete columns about 24 ft. centers, supporting longitudinal beams carrying a reinforced concrete deck slab. Beginning at the north end of the

long overall with four wheel trucks, 33 ft. centers and wheel loads of 12,500 lbs. each. Cars were assumed to take up 20 ft. of width of roadway, the live load on remainder of roadway on each side not occupied by cars, 150 lbs. per sq. ft. Live load on sidewalks, 80 lbs. per sq. ft. The live load for the arches proper was assumed as 200 lbs. per sq. ft. for a width of 20 ft. (the space occupied by cars), the remainder of the roadway, 150 lbs. per sq. ft. Sidewalks, 80 lbs. per sq. ft.

Dead Loads—Reinforced concrete, 150 lbs. per cu. ft.; paving brick, 50 lbs. per sq. ft., paving sand 20 lbs. per sq. ft. Hand

railing about 100 lbs. per lineal ft. Rails, connections, etc., 35 lbs. per lineal ft.

Unit Stresses.

The following unit stresses were used in the design of various parts of the structure.

Reinforced Concrete—

Beams, girders, slabs, etc.:

500 lbs. per sq. in. compression.

0 lbs. per sq. in. tension.

150 lbs. per sq. in. direct shear.

65 lbs. per sq. in. diagonal tension.

Columns:

500 lbs. per sq. in. in direct compression.

Reinforcing Steel—Beams, girders, slabs, etc.:

18,000 lbs. per sq. in. tension.

10,000 lbs. per sq. in. compression.

12,000 lbs. per sq. in. shear.

Columns:

10,000 lbs. per sq. in. direct compression.

Reinforcing Steel—

Beams, girders, slabs, etc.:

Flange stress, 16,000 lbs. per sq. in. tension (net).

Flange stress, 16,000 lbs. per sq. in. compression.

Web plates, 8,000 lbs. per sq. in. shear.

No bending taken by webs.

Loads on Foundations.

The foundations for the entire structure, except that for Pier "G," a combination arch abutment and pier for plate girder span, consist of concrete piles from 25 to 35 ft. in length, calculated to sustain a load of from 23 to 30 tons each. Pier "G" rests of white oak piles from 12 to 19 ft. long, with an assumed carrying capacity of about 12 tons each.

Arch Design.

In determining the stresses in the arches, the position and amount of dead loads being definitely fixed and known, the thickness of the arch at the crown was determined and an equilibrium polygon was constructed through three points, at crown and at each end, for the given loads. This polygon was made the axis of the arch and the thickness determined at each point. Thus for dead load only and dead load plus full live load the polygon coincided with the axes of the arch and for live loads over one-half and over one-fourth the span the polygon was well within the middle third. The entire arch computations were checked by the method of the elastic theory.

Materials.

The concrete for the entire structure consists of only one class, viz.: a 1:2:4 mixture, with crushed stone as the coarse aggregate. The reinforcing steel used was cold twisted square bars.

Details of Design.

Beam and Girder Spans—The approaches to the arch spans over the creek are of reinforced concrete beam and girder construction carried by reinforced concrete columns resting on concrete pile foundations.

In general the approach construction (Figure 2) consists of reinforced concrete cross girders about 4 ft. 6 in. deep supported on reinforced concrete columns, four in each bent, between these bents which are about 24 ft. centers extend longitudinal reinforced concrete beams (eight in number, not counting the deep fascia beams between the outer columns), carrying the reinforced concrete deck slab. At the north end next to the arch spans seven of the beam and girder spans are placed on the same skew as the arch piers and have spans of 24 ft.

The center line of the outer columns is 5 ft. 9 in. back from the face of the cantilevered sidewalks. These columns are 18 in. square, reinforced with eight $\frac{3}{4}$ -in. round bars tied together with $\frac{1}{4}$ -in. hoops on 6 inch centers. At a point 3 ft. above ground level the columns rest on plinths of concrete 2 ft. 6 in. square extending 4 ft. below ground to the tops of the concrete footing courses over the concrete piles. These plinths are reinforced with four $\frac{3}{4}$ -in. square bars extending up into the columns, the bars

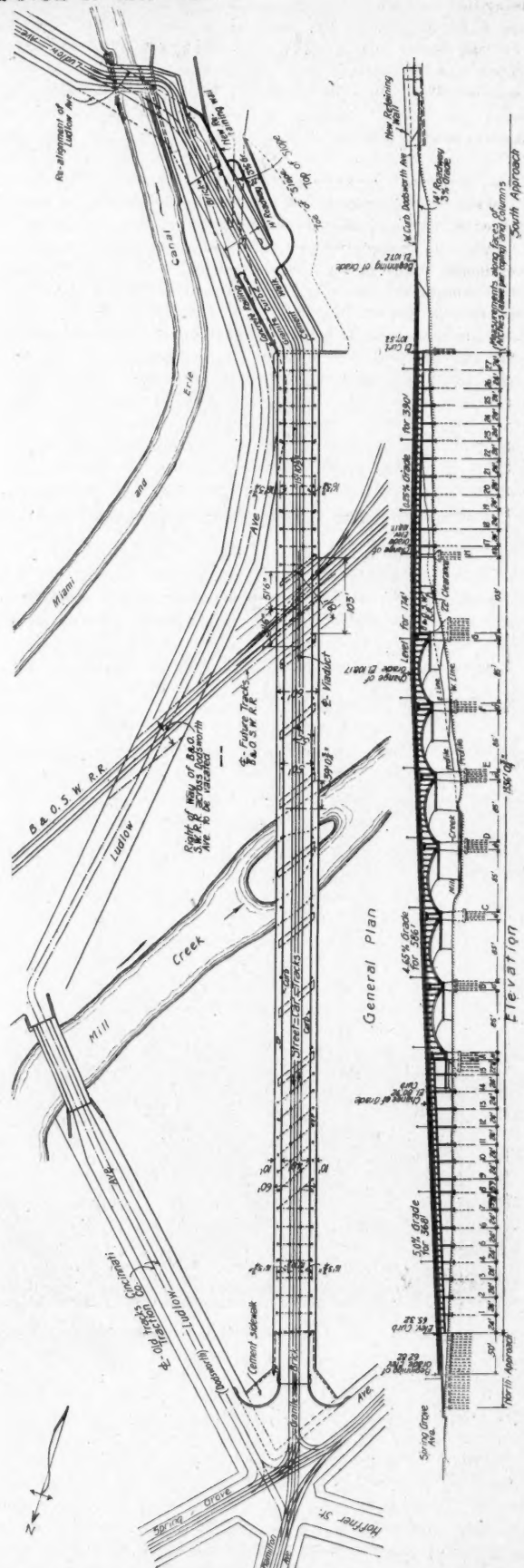


Fig. 1. General Plan and Elevation, Ludlow Avenue Viaduct.

being tied with $\frac{1}{4}$ in. hoops 6 in. centers. The footings 2 ft. thick are 6 ft. long and 3 ft. wide reinforced so as to distribute the load to the concrete piles two in number which project 9 inches into the footing. The two intermediate columns in each bent are 15 ft. $10\frac{1}{2}$ in. centers or 16 ft. $3\frac{3}{4}$ inches in from center line of the outer columns. These columns are 20 in. square, reinforced the same as the outer ones and rest on plinths 2 ft. 8 in. square of same height and reinforced the same as those previously described. The footing courses are triangular in shape with the corners cut off, resting on three concrete piles spaced in a triangle at 3 ft. centers.

The cross girders 12 inches wide are reinforced to act as continuous over the intermediate columns. The web reinforcement consists of $\frac{1}{4}$ in. sq. bar stirrups spaced 10 in. centers between floorbeams. In the square spans four $1\frac{1}{2}$ in. square bars are used while in the skew spans 6 bars are used. In one case two bars are bent up over each column and in the skew spans three bars are bent up, thus providing the same amount of

revealed posts 12 in. wide spaced 8 ft. centers, with a solid 6 in. wall between. The spandrel walls on the arch spans are of exactly the same detail as those on girder spans. The reinforcement for this fascia beam is shown in detail in Figure 2, while Figure 2A gives some idea of the spandrel or fascia construction used, the revealed arches however are not distinct on account of the shadows cast by the projecting sidewalk slab.

The reinforcement for the roadway slab, which is 6 inches thick, consists of $\frac{3}{8}$ in. square twisted bars 6 inches on centers transversely, alternate bars being bent up over supports to provide negative moment reinforcement. Longitudinal bars are placed in bottom of slab, four in each panel between beams. Longitudinal bars (two $\frac{5}{8}$ in. sq.) are placed in top of slab directly over the beams.

The sidewalk slab 5 inches thick has a span of 8 ft. between the cantilever brackets which extend back through the fascia beams into the beams under the curb. The main reinforcement consists of $\frac{3}{8}$ in. square twisted bars 9 inches centers, with alternate

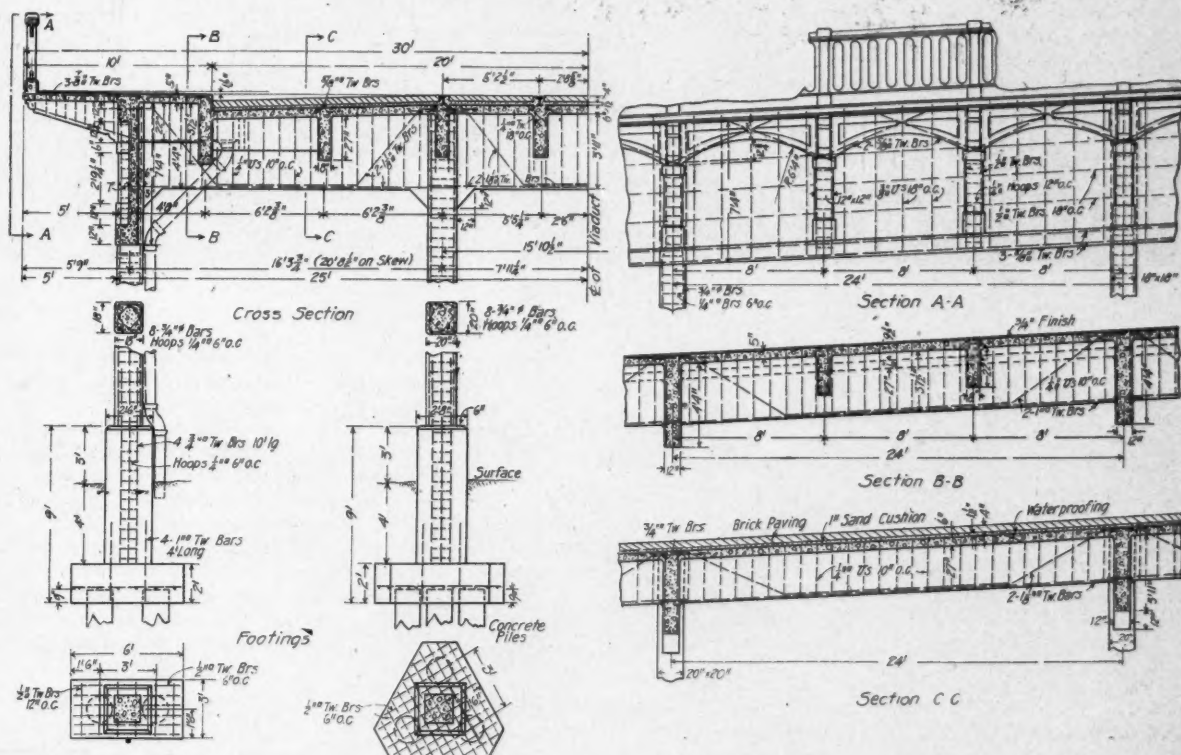


Fig. 2. Details of Beam and Girder Spans.

reinforcement over supports. At the junction of the girders with the columns 12 inch 45 degree fillets are placed.

The four middle beams or stringers, 8 in. x 2 ft. 9 in. deep, carry the street car rails, the beam under the outer rail in each case framing directly into the intermediate columns, the inner beams are spaced 5 ft. 5 in. beyond these. The reinforcement consists of four $1\frac{1}{2}$ in. square twisted bars, two straight and the others bent up over the supporting girders at each end. Web reinforcement consists of $\frac{1}{4}$ in. square stirrups spaced 10 in. centers throughout. The beams between the track beams and fascia two in number are similarly reinforced except that 1 in. bars are used instead of $1\frac{1}{2}$ in. The beam at the curb line is $9\frac{1}{2}$ inches deeper than the others, forming the curb at edge of the walk. The fascia beam is 7 ft. 4 in. deep under the sidewalk slab, which is 5 inches thick, and the outer surface of the same is molded and recessed to give the appearance of segmental spandrel arches with a radius of 6 ft. 4 in. carried on

bars bent up over supports, with three $\frac{5}{8}$ in. distributing bars at right angles to them in each panel. The brackets are 1 ft. 10 in. deep under slab at the connection with fascia beams and 8 inches deep at the edge of the sidewalk slab (See cross-section of approaches, Fig. 2).

The reinforcement consists of three $\frac{3}{8}$ in. sq. bars in top carried back into top of curb beam, and two $\frac{3}{8}$ in. bent bars in bottom of bracket with $\frac{1}{4}$ in. sq. stirrups spaced 6 in. centers outside the fascia beam.

At the edge of the sidewalk slab is a reinforced concrete handrail consisting of light posts over the spandrel columns, with a sill or curb between, cast with the slab with a groove for the openwork panel 2 inches thick which was placed later with a railing at the top.

The roadway slab is waterproofed and covered with a pavement of brick on a 1 inch sand cushion. The sidewalk slab has a $\frac{3}{4}$ inch granitoid finish.

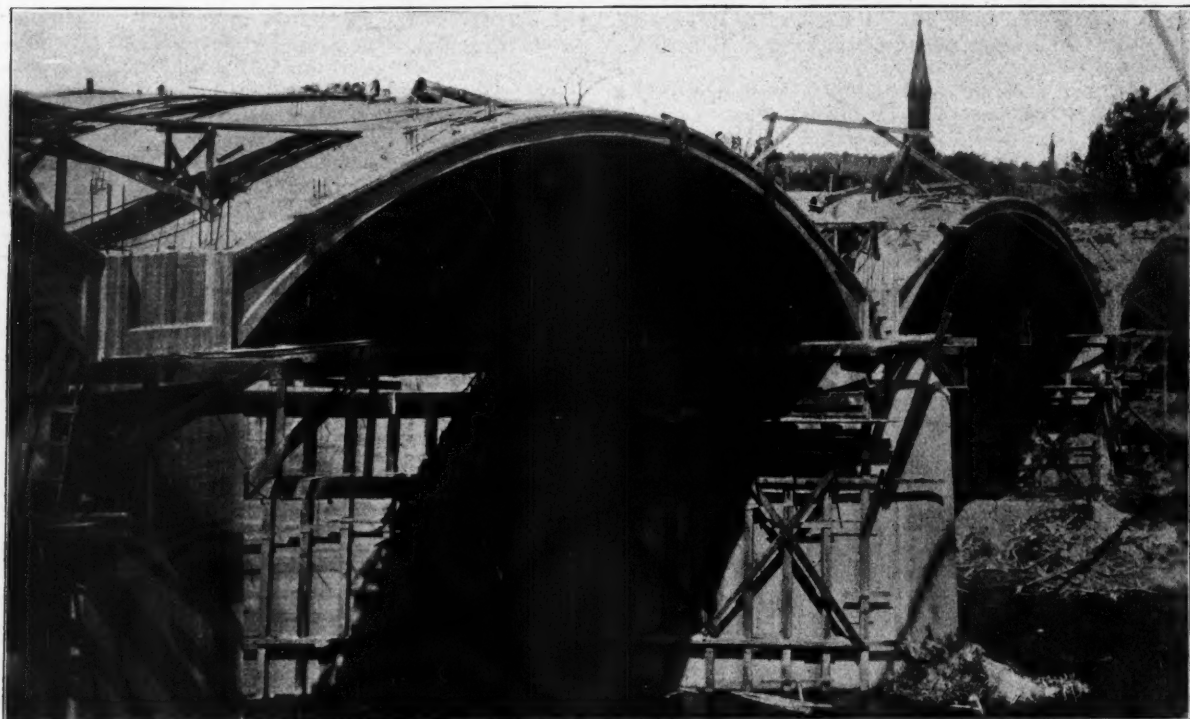


Figure 3-A. Construction View of Arch Spans, Ludlow Avenue Viaduct.

Arch Spans—The arches six in number are placed on a skew of 52 degrees and are of the solid barrel, three-centered type with a clear span of 85 ft. measured parallel to the center line of bridge, and a rise of 13 ft. 3 in. The arch rings are 2 ft. thick at the crown and are of the same thickness throughout the middle portion to points about 15 ft. from piers where the thickness begins to increase on account of the back of arch being on a tangent from that point to the pier. At the springing line the thickness is 5 ft. 2 in. measured vertically. This type of arch ring gives the arches an appearance of graceful lightness as can be seen in Figure 3A; however, a greater amount of reinforcement is required in these arch rings which are thinner than usually used, as will be found upon examination of the details (Figure 3).

At the crown section the longitudinal or main reinforcement consists of $\frac{3}{4}$ in. sq. twisted bars spaced 5 in. on centers at right angles to face of arch, placed $2\frac{1}{2}$ in. clear from surface of both extrados and intrados. The portions of arch rings from springing line to points about 20 ft. out from piers are reinforced with double the amount of steel used in the crown section, $\frac{3}{4}$ in. bars, 5 in. centers, being placed over and under the regular bars in intrados and extrados. All these bars extend well in the piers, and in addition thereto $\frac{3}{4}$ in. by 4 ft. bars spaced 12 in. on centers in two rows between main bars act as stubs to tie the arch ring to piers at the construction points which were made at right angles to the line of arch ring. The main bars in extrados and intrados are tied together by means of $\frac{1}{4}$ in. sq. bars 20 in. on centers longitudinally and 10 in. on centers transversely.

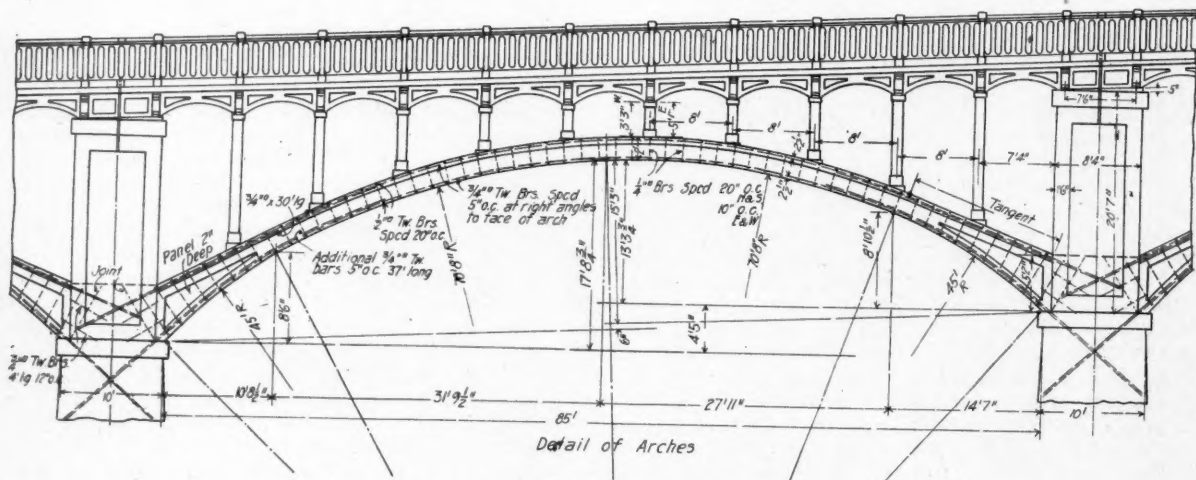


Fig. 3. Typical Detail of Arch Spans.



Figure 3-B. Construction View. Piers for Arch Spans Completed.

Transverse reinforcement consists of $\frac{1}{2}$ in. sq. twisted bars spaced 20 inches centers outside of the main bars. Under each row of roadway columns four additional $\frac{3}{4}$ in. bars are placed transversely in top and bottom of ring to distribute the column loads.

Piers—The piers of plain concrete 10 ft. wide at the top with a slight batter on sides. The footing courses over the concrete piles are reinforced concrete, projecting slightly beyond the network of the piers. Illustration C shows the arch piers with stub bars in place, ready to receive arch rings.

Roadway over Arch Spans—The roadway and sidewalk deck is

carried on 10 rows of longitudinal reinforced concrete girders carried on reinforced concrete columns spaced 8 ft. centers, the columns in the different rows being staggered as shown in Figure 4, so as to distribute the load in a more nearly uniform manner over the arch rings. These columns are 12 in. square, reinforced with four $\frac{3}{8}$ in. sq. bars and $\frac{1}{4}$ in. sq. hoops 6 in. centers. The vertical bars are spliced with stubs in arch rings by means of pipe sleeves. The girders under the roadway proper are 8 in. wide and 16 in. deep under slab (6 in. thick) and reinforced with four $\frac{3}{8}$ in. sq. bars, two straight and two bent at each end to provide negative reinforcement over columns. These girders

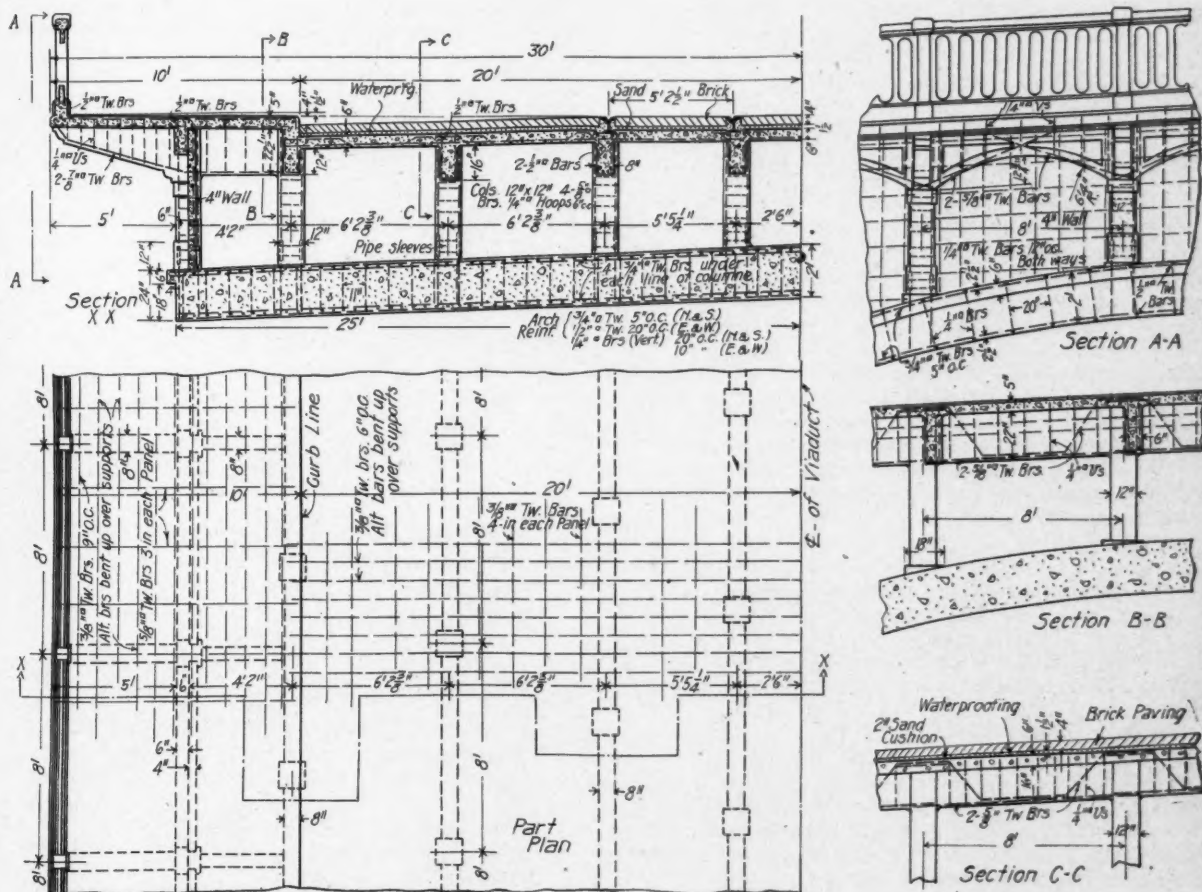


Fig. 4. Details of Deck and Spandrel Construction Over Arches.

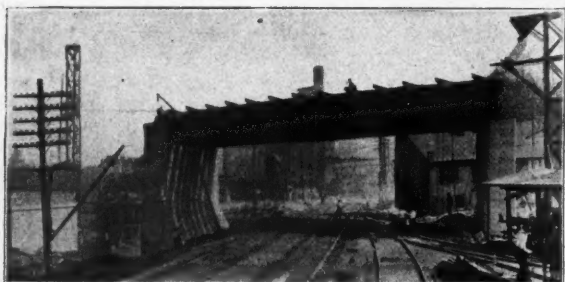


Fig. 5. Plate Girder with 110 Ft. Span, Ludlow Avenue Viaduct.

are also reinforced with $\frac{1}{4}$ in. sq. stirrups. The four middle rows of girders carry the rails for street car track, same being anchored to them directly, ties being dispensed with. The girders at curb lines are $5\frac{1}{2}$ inches deeper than the intermediate one and reinforced in the same way. The outer or fascia girders are molded in the shape of segmental arches with a radius of 6 ft. 4 in., a depth at the crown of 12 in. under sidewalk slab and a width of 6 in. A 4 in. concrete curtain wall is placed between columns and back of the fascia arch, making a closed spandrel, thus obtaining a construction in harmony with that used on fascia beams of approach spans. The curtain walls are reinforced with $\frac{1}{4}$ in. bars 12 in. centers both way. The fascia arches are reinforced with stirrups and two $\frac{5}{8}$ in. bars each way from columns, lapping by each other at the crown. Triangular shaped panels 1 in. deep are placed near spring of spandrel arches.

The sidewalk construction is similar to that on the approach span, viz., a 5 in. slab carried on cantilever beams spaced 8 ft. centers anchored to the curb girders. The roadway slab is 6 in. thick, reinforced the same as slab for approach spans and the top of slab is waterproofed. The handrail is the same as on the approaches. Expansion joints are provided in the roadway deck over each pier.

Plate Girder Span—At the south end of the series of arch spans is a plate girder span over the B. & O. S. W. R. R. tracks, which is one of the interesting features of the work on account of the unusual length of the girders used. The wide right-of-way and the clearance (22 ft.) required made the use of an arch span out of the question and steel plate girders were decided upon.

The girders in this span, ten in number, are deck plate girders 110 ft. long end to end and of 103 ft. clear span. They are all wrapped with wire mesh and encased in concrete. The six girders supporting the roadway are 6 ft. 2 in. back to back of flange angles and the four supporting part of the roadway and all of the sidewalk are 6 ft. 9 in. deep back to back of flange angles. All these girders are thoroughly cross-braced.

The concrete roadway deck and sidewalk over this span are reinforced in the same manner as for other spans. The cantilever brackets for sidewalk are made up of steel plate and angle brackets riveted to the outer girders. The fascia beams for this span are treated in the same manner as those of the approach spans so as to present a uniform appearance. Figure 5 shows the plate girder span in place before it was concreted.

Pier G—The pier at the north end of the girder span (left end in Figure 5) is a combination pier and abutment taking the thrust from the arches and the vertical load from the plate girder span.

This pier-abutment is founded on 205 white oak piles from 12 to 19 ft. long, extending 12 inches into the footing course which is 5 ft. thick and 32 ft. wide by about 74 ft. long. The footing course projects 1 ft. beyond neatwork at sides and 2 ft. at ends. The face toward arch spans is vertical and reinforced with 1 in. sq. twisted bars 25 ft. long, 6 in. centers extending downward from haunch line of arch; in this portion are $\frac{1}{2}$ in. bars 2 ft. ets. horizontal. The back of the pier is sloped as shown in Figure 6 to make it stable against the thrust of arches.

The pier is 10 ft. thick under the coping which is 1 ft. 6 in. thick and projects 6 inches beyond neatwork.

The portion above the springing line of arch is 10 ft. wide and of plain concrete with paneled ends and a coping just below the cantilever for sidewalk slab. A 3 x 6 ft. opening is provided through the middle of pier just above haunch of arch. The plate girders rest on cast iron pedestals and the portion between them over pier was covered up solid to top of girders. The end of the arch roadway construction has a sliding bearing on a steel plate, thus providing for expansion. Figure 6A shows pier "G" complete ready to receive girder and arch spans, note stub bars for connection with bars in arch rib.

Construction.

General—An interesting feature of the construction of this viaduct is the use of gravity distribution system for nearly all concrete work. High towers were erected at such points along the viaduct as to cover all points as were worked on at one time, concrete being placed directly in the forms without rehandling and therefore at a minimum cost. Concrete mixers were placed at each tower, the concrete after mixing, being elevated to the receiving hopper near the top of the tower and its discharge through the spouts regulated at this point so as to maintain a continuous flow of concrete. The trussed pipes of the distributing line were supported at intervals by adjustable lines dropped from cables stretched between towers. By an arrangement of pulleys attached to the main cable the length of the supporting lines could be adjusted so as to obtain the proper slope of discharge pipe for any particular location.

Foundations and Substructure—The excavation for the arch piers was done in cofferdams while the excavation for footings of approach spans was open trench work. The concrete piles of the Raymond "cast in place" type were driven as soon as the excavation permitted. Steel shells were driven with drop hammer pile drivers by means of a collapsible steel core which when

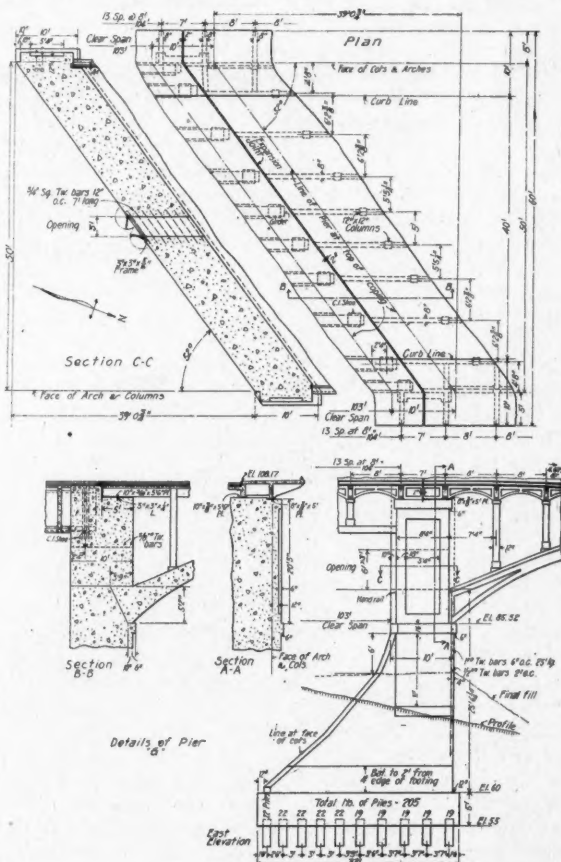


Fig. 6. Details of Pier "G."

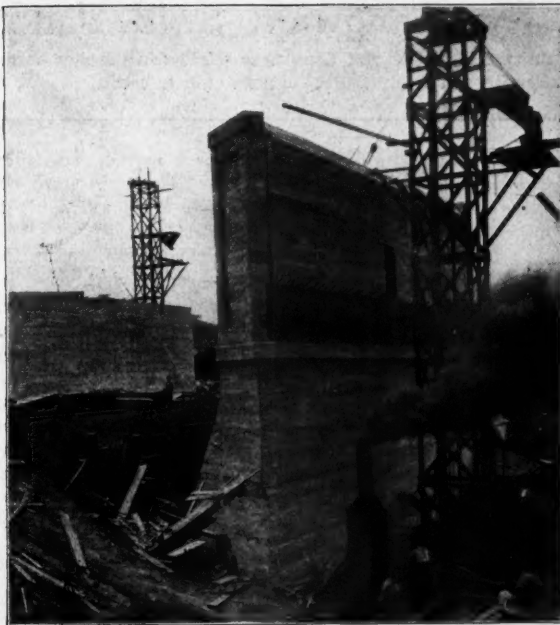


Figure 6-A. Pier "G" Complete, Ready to Receive Girder and Arch Spans.

the pile was driven to the proper penetration, was collapsed and the shell filled with concrete. The reinforcing for footings was then placed and the piles capped.

The concrete for the approach footings and concrete piles thereof was not placed by gravity, but handled in wheel-barrows directly from the mixer which was moved along as the work progressed. The concrete for piles in arch piers was placed by gravity chutes directly into the forms.

The arch pier forms were of wood construction built the entire height of the pier and heavily braced to prevent displacement due to rapid filling of the forms by the gravity chutes. As the tops of piers were reached the stub bars to tie the arch rings to the piers were put in place. All the arch piers were completed before work was started on any of the arch rings.

Approach Superstructure—The work of erecting the wooden forms for the superstructure of the approach spans followed directly behind the footing work. The formwork was erected complete and the concrete placed in transverse sections complete except for handrail which was cast later, the reinforcement for posts however being placed before concreting the sidewalk slab. The column, beam and girder forms were built in units so as to permit of their easy removal and erection at another point farther on. The intermediate supports for beam and girder boxes rested on mud sills with wedges at the top to keep forms at the proper height.

Plate Girder Span—The steel plate girders over the railroad tracks were erected and the forms for the concrete encasing them, hung from the structural steel so as to avoid any obstruction of the right-of-way. Before concreting, the girders were wrapped with wire mesh to furnish a tie for the concrete.

Arch Spans—The arch ring centers consisted of wooden trusses spanning from pier to pier (85 ft.) supported on timber bents resting on the pier footings and anchored to the pier which had previously been built. Upon these trusses the top chords of which conformed to the curves of the arches, was laid the lagging for the arch rings. Figure 3A shows clearly the type of centering used. The concreting was done in longitudinal sections of half the width of bridge. The centers being moved over to the other half of the ring as soon as the concrete had set sufficiently. A minimum amount of centering and forms was required by this method. After the arch centers were removed forms were erected for the spandrels and roadway con-

struction. Placing of reinforcing steel and concrete followed close behind the erection of forms.

The viaduct is now nearing completion and it is expected that it will be opened to traffic in a short time.

The writer is indebted to the Engineering Department of the City of Cincinnati, Mr. H. M. Waite, Chief Engineer and Mr. Frank L. Raschig, Engineer, Division of Structures, for plans, photographs and data used. The contractor for this work is Mr. Thomas P. Strack of Cincinnati.

CURRENT PRICES—CONCRETE MATERIALS.

Portland Cement—Shipments are at a somewhat heavier rate than at this time a year ago and while indications point to a light demand during the next month or two, the prospects for next spring and summer are steadily improving. Prices given are f. o. b. cars at points named, including cloth sacks, for which, in general 40 cents per barrel (4 sacks) is refunded on return in good condition. Prices per barrel (including 4 cloth sacks) are as follows: Boston, \$1.72; New York, \$1.58; Pittsburgh, \$1.50; New Orleans, \$1.78 on dock; Memphis, \$1.84; Cleveland, \$1.68; Detroit, \$1.64; Indianapolis, \$1.63; Toledo, —; Peoria, \$1.68; St. Louis, \$1.55; Chicago, \$1.50 to \$1.55; Milwaukee, \$1.59; Minneapolis & St. Paul, \$1.70 to \$1.75; Montreal, \$1.75 to \$1.80; Toronto, \$1.25; Winnipeg, \$2.40 to \$2.50; Kansas City, \$1.59; Omaha, \$1.78; Portland, Ore., \$2.20; Spokane, \$2.30; Seattle, \$2.10.

Crushed Stone—1½ in. stone, prices per cubic yard, f. o. b. cars in carload lots, unless otherwise specified. Boston, 80c per ton at the quarry; New York, 85c to 95c, in full cargo lots at the docks; Chicago, \$1.15; Toronto, 75c per ton at quarries; Spokane, \$1.25; Seattle, \$1.45.

Gravel—Prices given are per cubic yard f. o. b. cars in carload lots unless otherwise noted. Boston, 75c; New York, 85c to 95c, in full cargo lots at docks; Chicago, \$1.15; Portland, Ore., \$1.00; Spokane, \$1.25; Seattle, \$1.00.

Sand—Prices are per cubic yard, f. o. b. cars in carload lots unless otherwise indicated. New York, 50c, full cargo lots at docks; Chicago, \$1.15; Toronto, \$1.15; Portland, Ore., \$1.00; Spokane, \$1.00; Seattle, \$1.00.

Reinforcing Bars—The demand is light and prices in general have dropped about 10c per hundred lbs. below those given last month. Pittsburgh base quotations on mill shipments, f. o. b. cars are from \$1.25 to \$1.30 per cwt., with the prevailing extras on bars under ¾ inch or base. The following are quotations on base bars per 100 lbs., for mill shipments from other points, f. o. b. cars; Chicago, \$1.43 to \$1.48; Portland, Ore., \$2.20; Spokane, \$2.70; Seattle, \$2.00.

Shipments from stock are being made at the following prices per cwt. f. o. b. cars: Pittsburgh, \$1.75; New York, \$2.15; Cleveland, \$1.75; Cincinnati, \$1.75; Chicago, \$1.85 to \$1.95; Montreal, \$2.15; Toronto, \$2.25; Winnipeg, \$2.50; Portland, Ore., \$2.40; Spokane, \$3.20; Tacoma, —; Seattle, \$2.25.

Metal Clips for Supporting Bars—\$7.25 to \$8.00 per 1,000 depending on size.

For the majority of the prices given we are indebted to the Universal Portland Cement Co., Concrete Steel Co., Chicago, and F. T. Crowe & Co., of Seattle, Portland, Spokane.

Reinforcing bars for mill shipment are in general sold on a Pittsburgh basis; that is, at the Pittsburgh quotation plus the freight to the point in question.

From Pittsburgh, carloads, per 100 pounds to:

Albany	16 cents	Cincinnati	15 cents
New York	16 cents	Louisville	18 cents
Philadelphia	15 cents	Chicago	18 cents
Baltimore	14½ cents	Richmond	20 cents
Boston	18 cents	Denver	84½ cents
Buffalo	11 cents	St. Louis	22½ cents
Norfolk	20 cents	New Orleans	30 cents
Cleveland	10 cents	Birmingham	45 cents
Columbus	12 cents		

Langwies Viaduct—Chur-Arosa Ry., Langwies, Switzerland *

A Noteworthy European Structure With a Main Arch Span of Unusual Dimensions and Long Span Girders in the Approaches
—A Most Interesting Design of Centering, Combining Wooden Falsework and Reinforced Concrete Tower Supports.

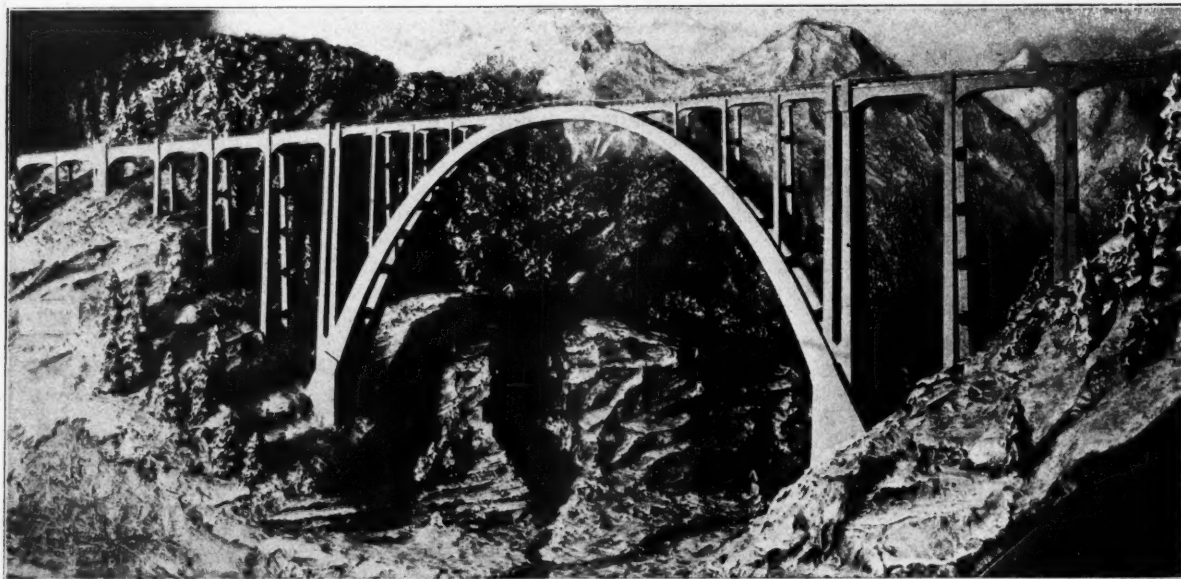
By A. M. Wolf, C. E.

Comparison With Other Concrete Arches.

The developments made in the last decade in the design and construction of large concrete arches have been toward the gradual increase in the main dimensions of such structures as will be noted in the following historical outline. In 1906 the largest arch span was the famous Walnut Lane arch at Philadelphia, Pa., with a clear span of 232 feet. In 1909 the Stein-Tufen arch in Switzerland, with a span of 259 feet, was built. The year 1911 saw two long-span arches completed, viz., the Risorgimento arch over the Tiber at Rome, with a clear span of 328 feet 1 inch (100 m.) and a rise of about 32 feet, and the Auckland, New Zealand arch, with a clear span of 320 feet and a rise of 84 feet. The Larimer Avenue arch, Pittsburgh, Pa., with a clear span of 300 feet 5 inches and a rise of 67 feet was completed in 1912. Now, in 1913-14, an arch exceeding in greatness all these structures, when one considers the span, rise and load carried, is being

the mountains of Switzerland in the lower part of Arosa near Langwies at an elevation of 4,330 feet above sea level. The structure bridges a deep gorge close to the junction of the Sapüner Brook and the Plessure River.

The entire structure is of reinforced concrete construction with a total overall length of 285 meters, or 935 feet, consisting of the arch span of 314 feet 11½ inches clear span and four continuous girder spans of 52 feet 6 inches c. to c. span, carried on high concrete bents, at each side of the arch and three additional girder spans at the Langwies end (left end in illustration A). Two of these latter are 42 feet 8 inches (13 m.) clear span and one of 32 feet 9½ inches (10 m.) clear span. The overall width at the crown of arch is 16 feet 6½ inches. The arch is composed of two ribs with fixed ends, braced at intervals by transverse struts of reinforced concrete. The roadway deck is carried by continuous girders on reinforced concrete



"A." The Langwies Viaduct as It Will Appear When Completed. (Reproduction from Model.)

constructed. This arch is the Langwies arch of the new Chur-Arosa railroad in Switzerland, with a clear span of 314 feet 11½ inches, a rise of 134 feet 3 inches and a crown height above the valley of about 203 feet. Thus it will be seen that, although the span is about 13 feet shorter than that of the Risorgimento arch and 5 feet shorter than that of the Auckland arch, the rise exceeds that of the former by about 102 feet and that of the latter by 50 feet. The only structure with a rise anywhere near as great as this is the Monroe Street arch at Spokane, Wash., with a span of 281 feet and a rise of 113 feet. The Langwies arch is designed for a narrow gage electric railway, while the others are for heavy highway loading only. As far as esthetic design is concerned the Langwies arch outranks by far the two other arches just mentioned and although not as artistic as the Larimer Avenue bridge is an excellent example of a plain, but graceful design.

Considering the facts just mentioned the statement that the Langwies arch is the greatest concrete arch in the world is easily justified.

General Description.

The Langwies viaduct of the new Chur-Arosa railroad (3.28 feet, 1 meter gage), a part of the Rhätische Bahn, is located in

* Copyright 1914, A. M. Wolf.

columns spaced about 29 feet 6 inches centers longitudinally, resting on the arch ribs. Illustration "A," a photograph of the miniature reproduction of this remarkable structure which was exhibited at the late concrete exhibition at Leipzig, shows very clearly the gigantic proportions of the entire viaduct.

Esthetics.

The appearance of the entire structure is one of extreme lightness in spite of the massive character of the work. This is due to the great height of the arch and the approaches, and the comparatively light construction used in the roadway deck supports. The architectural treatment of all parts of the viaduct is very simple; the plain but graceful lines, the balance of proportion of parts, the gigantic size of the structure and the picturesque surroundings in a very rugged mountainous country, being relied upon entirely for the artistic beauty of the work. The ingenious method used to preserve the symmetry of the main structure is worthy of comment. At the Langwies end, as shown in illustration "A," are three additional approach spans (only two are visible) separated from the four main approach spans by a heavy abutment pier. This effectually divides this approach into two parts and makes a much more pleasing design than

would have been obtained had this pier been of smaller proportions, which would have given the structure an unbalanced appearance.

Conditions and Loadings Governing Design.

A long-span arch was of course the logical solution of the problem of bridging the deep mountain gorge and for economical reasons a twin ribbed arch was used. On account of the very favorable foundation conditions the main arch was proportioned and designed as a fixed arch in accordance with the method of the elastic theory as presented by Professor Mörsch. The structure as designed required no reinforcement for dead and live load stresses, being so proportioned as to keep the line of pressure well within the middle third of the ribs. To provide for such tensile stresses as might arise due to temperature changes and rib shortening alone or combined with the dead and live load stresses, steel reinforcement was used in both extrados and intrados of the arch ribs.

arch ribs were given a 4 per cent batter or flare from crown to the abutments. The inside faces of the ribs were also battered toward the abutment, but not so much as the outside faces, in order to secure the additional required strength toward the springing.

The live load used for the design of the viaduct consisted of one train of two electric locomotives each of 65 tons maximum weight (locomotives of the Rhätische Bahn) followed by an unlimited number of freight cars. The stresses in the materials for was plain round bars of medium steel.

Details of Design.

Arch.—The main arch ribs, two in number, with a theoretical span of 328 feet 1 inch, a clear span of 314 feet 11½ inches and a theoretical rise of 137 feet 9½ inches, are 2.10 m. or about 7 feet deep and 3 feet 3½ inches (1 m.) wide at the crown. The depth of the ribs is increased toward the springing, as is the

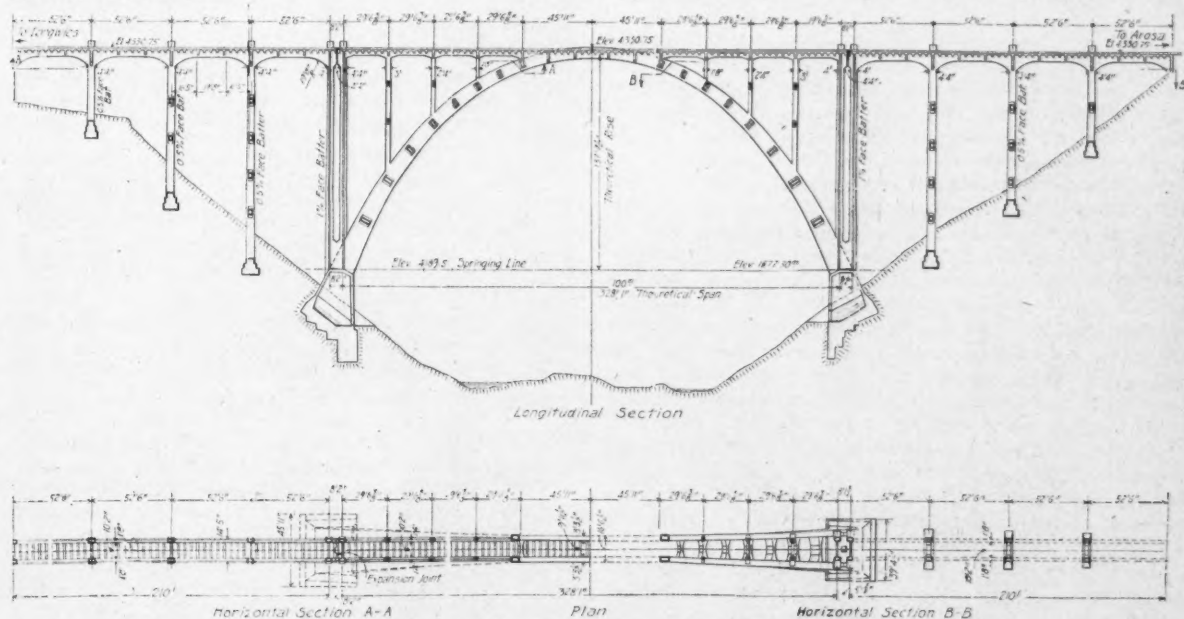


Fig. 1. General Details of Langwies Viaduct.

For the approach spans continuous girders were decided upon because the great height of the roadway above the ground made a structure free from horizontal thrust very desirable.

The structure being subjected to great variations in temperature because of its altitude of 4,330 feet above sea level, made special provision for expansion necessary. The roadway deck was therefore divided by expansion joints at the double piers over the arch abutments, the high intermediate piers being sufficiently elastic to permit of longitudinal expansion of the deck without overstressing them.

The main object to be fulfilled in the design and construction of this bridge was: (1) To keep the actual stresses as low as possible and at the same time (2) to save as much material as possible. On account of the relatively small live load as compared with the dead load, these conditions could readily be complied with by the use of an arch composed of two ribs instead of a solid barrel arch.

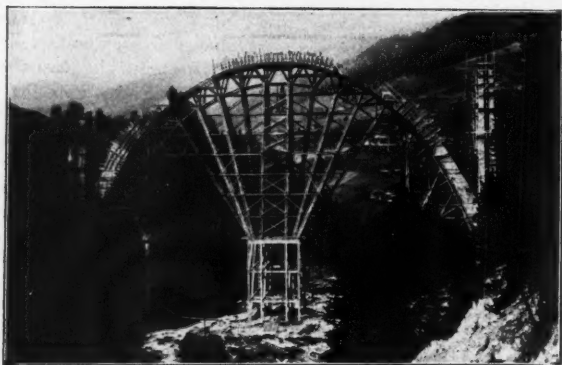
By designing the deck of the approach spans as a series of continuous girders which transmit the wind stresses directly to the end abutments and to the large double piers over the arch abutments, the approach piers could be consistently made of light construction consisting of two main posts of reinforced concrete tied together by struts of the same material. Because of the stresses transmitted, by this method of design, to the double piers it was necessary to connect each pair of these posts with a solid transverse wall.

In order to secure greater stability, the exterior faces of the

width of same, in accordance with the batters previously noted. The ribs are reinforced with plain round bars placed near intrados and extrados to provide for temperature and rib shortening stresses. The two ribs are securely tied together at intervals of about 15 feet (measured horizontally and not following the line of rib) by reinforced concrete struts with heavy fillets at the rib connections to give added stiffness. At the crown the ribs are spaced 9 feet 11½ inches apart, making the total overall width 16 feet 6½ inches. At this point the arch ribs extend a little above the level of the deck, thus preserving the outline of the arch ribs very effectively. (See Illustration "A" and Figure 1.)

Arch Abutments.—The arch abutments of plain concrete are carried down to solid rock, the bottoms of same being stepped to add stability and prevent sliding. The faces of the abutments are vertical while the backs are sloped in a line parallel to the thrust line in the ribs at the spring. The left abutment (Fig. 1) is 45 feet 11 inches wide, while the right abutment is only 39 feet 4½ inches wide, the difference being due to the difference in character of the foundations on the two sides of the valley.

Roadway Deck on Arch Span.—The roadway deck (see Fig. 1) over the arch span is carried by four pairs of posts spaced 29 feet 6 inches centers resting on the arch ribs. These posts or columns vary in width from 1 foot 8 inches for the ones near the crown to 4 feet 4 inches for the ones over the abutments. They are of reinforced concrete and are tied together in pairs by transverse struts. Over the abutments are twin piers, each con-



"B." Side View of Arch Under Construction.
Note the Horizontal and Diagonal Longitudinal Bracing of Centering.

sisting of two heavily reinforced posts tied together by a solid concrete wall instead of struts. These piers, 4 feet 4 inches apart, are tied together at the bottom and separated at the top by an expansion joint. One acts as the end pier for the roadway girders over the arch and the other as end pier for the girders of the approach spans.

The roadway deck construction consists of a reinforced concrete slab carried on cross beams about 4 feet 2 inches centers, supported by longitudinal spandrel girders continuous over the spandrel columns. The girders are rigidly connected with the arch where they intersect the ribs near the crown and also with the tall piers over the abutments, which provide for expansion by their elasticity. The cross beams at the piers are of greater depth than the others to provide extra lateral stiffness. All slab and girder connections to their supports are provided with haunches to care for the compression due to continuous action.

The roadway has a width of 13 feet 1½ inches (4 m.) between railings, 2 feet 4 inches on each side being used for the sidewalks. The concrete deck slab has a cement finish and is waterproofed. Upon this is spread a layer of sand and then a layer of crushed stone 1 foot deep, upon which the track is placed.

Approach Spans.—The roadway construction, including cross beams and slab for approaches is the same as that just described. The main girders, however, are of much longer span, viz.: 52 feet 6 inches c. to c., 48 feet 2 inches clear span, and consequently of greater depth and width, the latter being 1 foot 8 inches as against 1 foot 4 inches for those over arch. These girders are designed as continuous beams with a variable moment of inertia with rigidly fixed ends at the abutments and elastically framed into the intermediate piers and the double piers. The ends of girders are curved to a radius of 19 feet 8 inches for a portion 16 feet 5 inches out from center lines of piers with a tangent portion 19 feet 8 inches long, between. This gives the girders a very pleasing appearance as well as adding greatly to their strength.

The approach piers each consist of two posts 4 feet 4 inches wide with battered faces, resting on stepped footings carried down to rock. The posts of the higher piers are tied together at intervals by cross-struts with heavy fillets at ends. The posts of the approach piers and the double piers over abutments are carried up above the deck as projecting pilasters, thereby defining more clearly the approaches from the main arch construction. The three additional approach spans at the Langwies end are not shown in Fig. 1. Their construction is same as that of the other spans, but they are designed independent of the others, being separated by a wide abutment pier.

Construction.

General.—The construction work on this structure was started in August, 1912. The arch centering was started in the spring of 1913 and completed in the early part of September. The arch ribs were finished about the middle of October and the approach spans at the Arosa end of the viaduct were practically complete

at this time. The approaches at the Langwies end were not so far advanced, little more than the foundation work being completed. The deck construction over the arch will be completed this spring.

On account of the early and severe winter prevailing in the mountains until the end of March, work is suspended at the present time. The bridge will be completed about June, 1914, and will be opened for traffic in the fall of 1914, the time set for the opening of the new Chur-Arosa line.

Foundations.—The excavations for foundations were carried down to solid rock through the moraine and drift formations. The necessity of penetrating this moraine deposit caused considerable delay in the construction work on account of the extra depth of excavation required at one abutment in order to obtain the desired solid rock foundation.

Centering and Falsework.—The unique type of centering used for the main arch is of special interest. This centering consists of a central fan-like wooden falsework with radial ribs supported on a reinforced concrete tower consisting of four bents securely tied together and two single reinforced concrete bents, one near each of the abutments, supporting wooden falsework in the shape of a half fan with ribs fanning out toward the abutments. The wooden falsework consists mainly of round, unhewn timbers which was on the ground in good quality, long lengths and at low prices. The reinforced concrete towers were designed as latticed bents.

The following considerations led to their adoption for the lower part of the centering.

(1) On account of the great danger of flood to which the location is subject during the melting of the snow, situated as it is at the juncture of two rapid streams which often carry enormous quantities of water and solid matter (driftwood, boulders, etc.), it was necessary to restrict the waterway as little as possible. For this reason it was impossible to use vertical bents for the

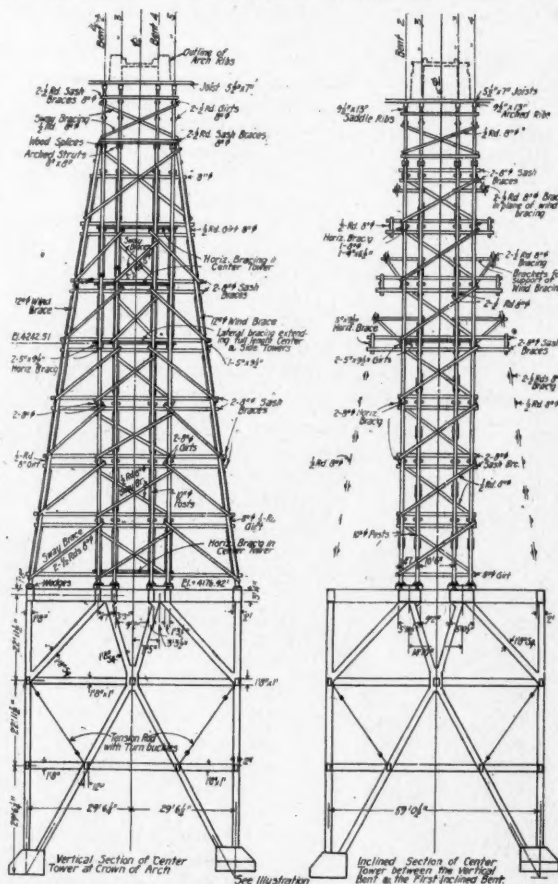
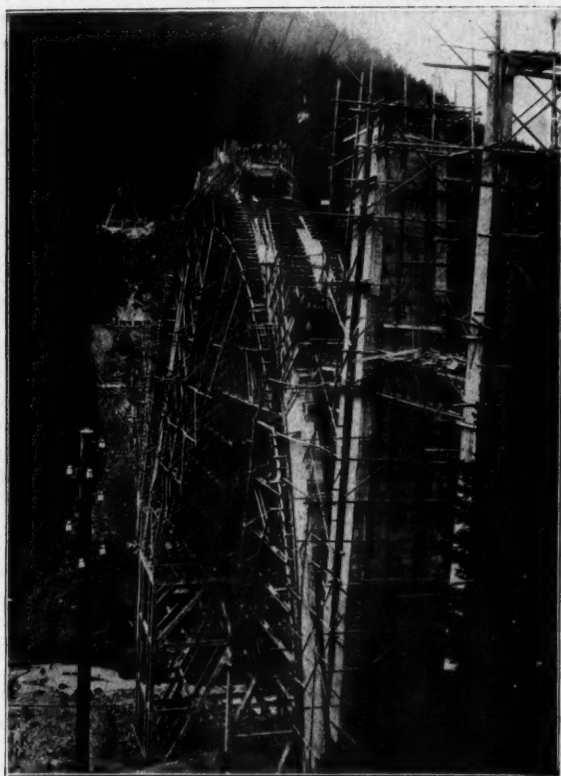


Fig. 2. Details of Central Tower, Showing Reinforced Concrete and Timber Framing.



"C." End View of Arch Centering—Arch Ribs Being Concrete.

falsework and the tower system had to be used. Wooden towers would not have been as safe as the adopted concrete towers and would have reduced the waterway considerably more.

(2) Even if wooden towers had been used to support the centering the foundations would necessarily have had to be of concrete, as the driving of piles through the moraine deposits of gravel and large boulders was absolutely impossible.

(3) It was desired to reduce the vertical deformation (compression) of the centering during pouring of the arch ring to a minimum. This could be obtained much better by the use of reinforced concrete towers than by using wooden towers. That the adopted design was a success in this particular is witnessed by the fact that after the arch ribs were completed a total settlement of a trifle less than 20 m.m. ($\frac{3}{4}$ in.) was observed in the centering.

Details of Arch Centering.

Central Tower.—The central portion of the arch centering is carried on a three-story tower consisting of four reinforced concrete bents, 77 feet high and 60 feet 8 inches wide, thoroughly braced in both directions by diagonal and horizontal struts of reinforced concrete, and resting on concrete footings. The details of these bents are shown in Figure 2. When one considers that this tower is only a temporary structure the magnitude of the work is more firmly impressed on the mind. It shows conclusively the remarkable possibilities of reinforced concrete as an aid in carrying out heavy construction work.

The central falsework carried on the concrete tower consists of two vertical bents at the middle and four inclined bents on each side. These bents, composed mostly of round, unhewn timbers with wedge blocking at the bottom, have a heavy batter to resist lateral pressure due to wind (see Illustration "C"), and are thoroughly sway braced both horizontally and diagonally, as shown in Fig. 2. They are also securely braced and tied together longitudinally. (See Illustration B.) Near the top the bents are tied together by a line of arched struts following very closely the line of arch rings. Above this the bents branch out into three sets of struts which support the saddle timbers which

carry the arched timber ribs upon which the transverse joists supporting the lagging and forms for arch ribs are placed.

Side Towers.—The side towers near the abutments consist of single bents of reinforced concrete, 40 feet 6 inches wide, built in a similar manner to those of the central tower, but much thicker (3 feet 4 inches measured in a direction transverse to bent). These bents which support one vertical and two inclined bents of timber falsework are tied to the abutments by steel I-beams to brace them longitudinally. (See Fig. 3.) The timber framing in these bents is similar to that in the main portion and is shown in detail in Figure 3. The side falsework is tied to the central falsework near the top of the former by a continuous set of horizontal, diagonal and longitudinal bracing. The timber bents are blocked up on the concrete by means of hardwood wedges, resting on short blocks of concrete placed across the top of the concrete bent which is widened at the top to receive them. The illustrations show very clearly the details of the unique falsework construction.

Falsework for Approaches.—The piers of the approach spans were carried up in forms partially self-supporting, a light wooden framing of round timbers being built up around the piers.

The forms for approach girders are carried on pairs of steel trusses with top chords following very closely the desired outline of bottoms of girders. These trusses were made somewhat shorter than the distance between piers and they were therefore easily raised in successive lifts with the aid of the falsework around towers, to their positions at the top of piers where they rest on projecting brackets built on piers. (See Illustration "C.") These trusses are securely braced together and carry the entire formwork for the continuous girders and the roadway deck. Illustration "D" shows the two trusses for the right hand approach

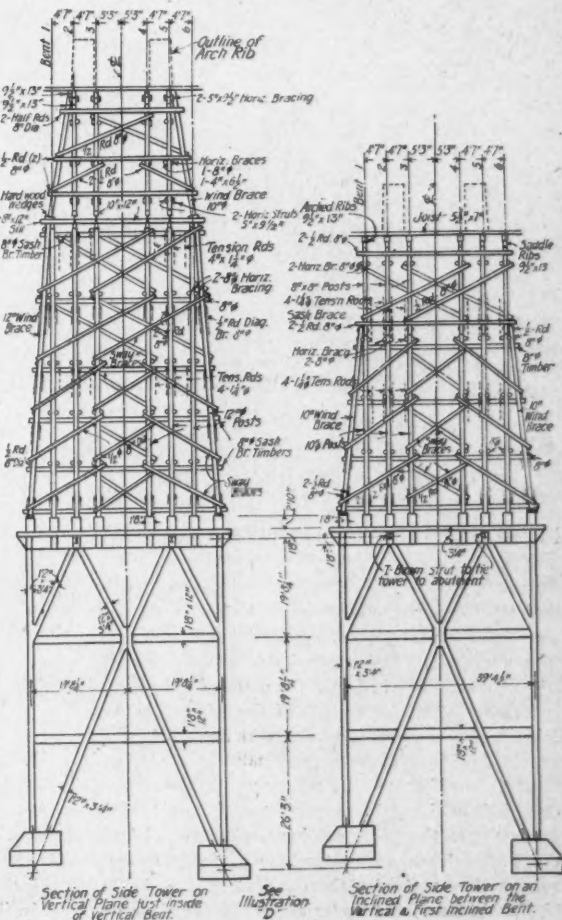
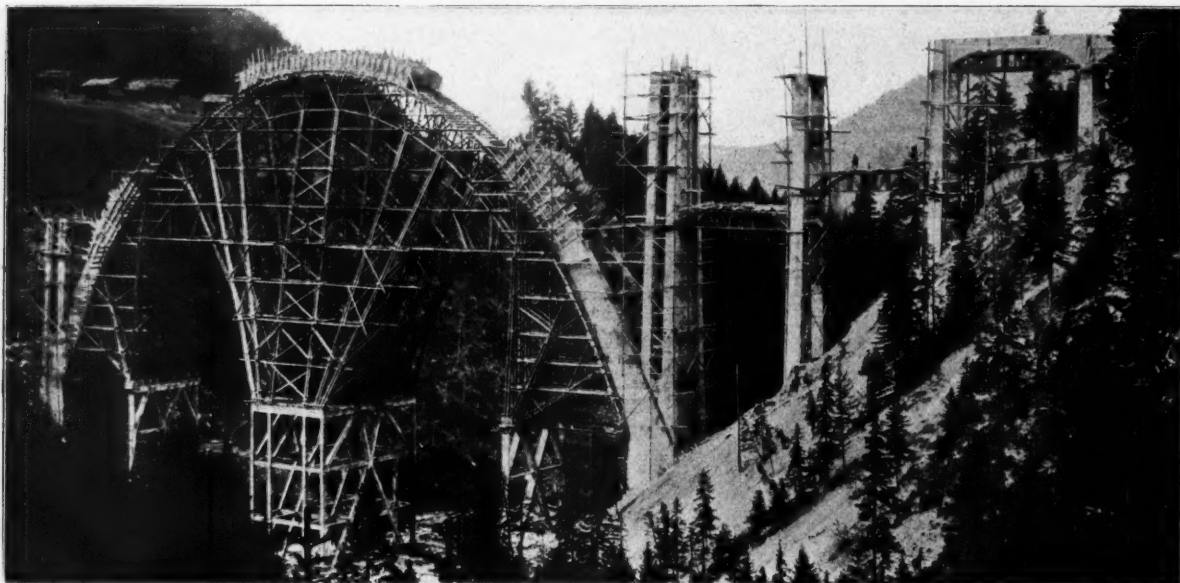


Fig. 3. Details of Reinforced Concrete Tower and Timber Centering Under Arch Haunches.



"D." General View of Arch and Approach Span Centering, Langwies Viaduct.

spans in place with forms started, while the other two are being raised. The approach at the Arosa end having been completed this fall, the steel trusses will be taken down and used again next spring in completing the Langwies approach.

Concreting.—The concrete which was mixed rather dry was carried from the mixing plant to the point of discharge in large buckets traveling on an aerial cableway. The bucket conveyor was so arranged as to permit of lowering and discharging at any point on the work.

The concrete, which was rather dry, was firmly rammed into place. In concreting the arch ribs work was carried on simultaneously on both ribs, starting from the springing lines at both sides. After placing a section of concrete near the springing, work was started at the crown and proceeded both ways to meet the side sections. Work on these three sections was carried on continuously until predetermined keyways were reached, where the ribs were afterward keyed together.

The high piers were concreted in sections of considerable height, the forms being raised and placed for another section a few days after completing the previous one. Illustrations "B," "C" and "D" show various stages of the construction work of arch and approaches.

The viaduct was designed and built by Ed. Züblin & Co., engineers and contractors, of Strassburg, Germany. The writer is indebted to Mr. H. Schürch, chief engineer of the above company, for plans, photographs and data used in this article.

CONCRETING.

By W. J. Potter.

Successful concreting may be divided roughly into two main parts, the proper combination of elements making the whole and the proper handling of this mixture to best carry out the purpose intended. These main heads are divided into many subdivisions, each of which like the parts of a machine, have definite importance in the perfection of the whole. While as in a machine, a poor part may do the work intended, yet it will not do as much work or of the same quality as a perfect part. So, in concrete working, an operation may do the work intended, but the whole will not be as perfect as it might if this component part or operation does not harmonize with the general tone of the work. Thus no matter how perfectly materials have been mixed, the properties thereby gained may be lost in placing, if, for instance, the materials are dropped for a considerable distance, or again, if after being deposited, they are not worked or puddled.

Taking up the first question, that of mixing, we have the most important phase, the determination of proper proportion. Engineers differ as to the proper method of measuring material. Some men favor quantity measure, advancing the theory that what is lost in actual quantity is made up in time saved. Machine measurers are arranged on this principle. Just at present, the mechanical weight measurers have not been perfected sufficiently to admit of practical value upon small jobs. Taylor & Thompson assert the supremacy of measure by weight, advancing economy of material as supporting their argument.

The next point in importance is the consistency of the mixture. This is brought about only by the most thorough mixing. The consistency giving best results in re-inforced concrete is such that the mass will move slowly in and around all obstructions. In ordinary mass, concrete should be jellylike, so that it quakes readily when being worked. Concrete congealing before its being placed and worked indicates that the cement is too rapid and mass must be hardened under water. Dry concrete well mixed and tamped is available at shorter notice and stands severer tests; but the danger lies in the dry pockets, which weaken the mass, admit water, and later show in form of pocks, when near a surface subject to hard usage. Occasionally, where a too wet mixture is used, the light ingredients do not flow around the stone and when boarding is removed, the mass has a honey-combed appearance, with the further disadvantage of crumbling unless patched.

Cement is the binding agent in concrete; neither the stone nor sand is of value till bound by some adhesive agent. Mixing by hand, the sand and cement should be mixed first, both ingredients being dry and then applied to the granolithic grit. There are several rule-of-thumb methods concerning the period at which water is to be applied and the best method is a matter of opinion. In my own case, I believe in well mixing the sand and cement and then adding water, and finally the stone. The oftener the mass is turned the better the lighter ingredients will move about and attach themselves to the heavier. The idea is to have the binding force so disseminated throughout the mass that each particle of cement will exert its influence upon a foreign substance, and hence gain the maximum binding efficiency. This highest effectiveness is gained before the water or stone has been added to the mass. Sand and cement will affiliate better when dry. They will take the water better when together and insure more perfect plasticity without dry powdery cement spots.

The relative importance of machine versus hand mixing is a question largely determined by circumstances. Where it is a question of small jobs with time as an influencing factor, the old hand method is better. Labor is cheap, the plant (an iron sheet) inexpensive, and transportation a minor factor. However, on large jobs, where the material is heavy, the need of accuracy imperative, the mixing and measuring by machine is far superior to hand work. It produces better concrete, is more economical and pays for itself in wages and time saved.

In distributing, the chief object is to produce a mass of uniform consistency. Dump cars on rails, in carrying-on large operations, are of great economy, permitting rapid and thorough working where the distance from dump car to forms is not very great. A fall of five feet will disarrange the particles of mixed concrete, and will force stones to the bottom without their having sufficient adhesive element to bind properly, besides expending more material than necessary or practical. Only very wet concrete can stand much of a drop without disarrangement and even then the results do not justify such a method. A trough running from the dump cars to the form will distribute material evenly and gently without disturbing the relative consistency of the mass, and without destroying any of the advantages gained by thorough mixing of component parts. Ordinary concrete will run on an incline of one in seven, or even one in nine. In placing the concrete it should not be laid deeper than ten inches without ramming. Of course this thickness varies according to the consistency of the material, and the degree of wetness. The method of scattering and working the mixture in thin layers as soon as it is placed in forms, is more advantageous than placing a great depth before working, or delaying the working of material until it has started to stiffen.

The thoroughness with which the material has been tamped or settled has the greatest influence on the ultimate strength and appearance of the finished product. When the concrete has been sent with a rush into the forms, like any liquid or glutinous mass, it takes air particles with it, and because of its nature the air bubbles which are formed do not come readily to the surface. The mixture must be worked over and settled. These small air bubbles in the puddling combine on contact and when sufficiently large, rise to the surface and liberate the air. Air has great elasticity and when compressed is capable of keeping the lighter materials of concrete at bay till the hardening of the latter leaves an air cell, which is a defect leading to greater defects. I have found it of great advantage to work over the materials when laid, with a garden fork or spade. Care must be exercised when puddling not to exert a force too great for the containing forms. A yield in the latter leaves an ugly bulge which is not alone unsightly in itself, but spoils the appearance of a large stretch of the work. Foot tamping with a spade, to allow cement to ooze outside of the rock center and form a smooth facing surface, is liable to strain the forms likewise. Light material in making the latter, or loose carpentry in their construction affect the looks of the finished whole and gives it the appearance of bungling.

The chief object in ramming a dry mixture is to compel uniform distribution of the cement under and around the rock particles. In tamping the very wet mixture blows are light, just strong enough to force out the imprisoned air. In this operation we have the finishing touches to the job. There are many types of tamping irons, answering the same purpose, their use being a matter of opinion. No hard and fast rules can be laid down in finishing off the job. Local conditions vary and affect the work. Best results are gained by the observation of all established rules, and where conditions are unprecedented, then by the application of the engineer's ingenuity.

SAFETY RULES FOR PILING CEMENT.

The June issue of the "Journal of the Engineers' Society of Pennsylvania" contained an article on "Safety, Relief, San-

itation and Welfare in the U. S. Steel Corporation," from which the following rules are abstracted in concrete. These rules are worthy of study and advocacy by all engaged in concrete construction.

Rules for Piling Cement.

- (1) Cement shall not be piled more than ten bags high, except in storage built for such purpose.
- (2) The first four end bags should be cross-tied in two separate tiers up to the fifth bag, where a step-back of one bag in every five bags shall be made. Beginning with the fifth bag, only one cross-tier will be necessary.
- (3) The back tier should, when not resting against a wall of sufficient strength to withstand the pressure, be stepped back one bag in every five bags, the same as end tiers.
- (4) In storage, when piled between and against walls of sufficient strength to withstand the pressure, no cross-tiers nor step-backs will be necessary but the bags should be piled with a slight incline against the back walls, the height depending on the strength of the wall.
- (5) Cement bags in the outer tiers shall in all cases be piled with the mouth facing the center of the pile.
- (6) When cement is removed from a pile the length of the pile shall be kept at an even height, and necessary step-backs, every five bags, be taken care of.

MIXING AND PLACING CONCRETE BY COMPRESSED AIR.

Many different kinds of work are being done by the Kansas City Terminal Ry. in connection with the extensive operations involved in the construction of the new terminal station at Kansas City, Mo. One of these jobs, the building of the O. K. Creek sewer, 6160 ft. long, part circular in section and the remainder of a double box section is of interest on account of the methods used in mixing and placing concrete, viz.: by compressed air.

A pneumatic conveying concrete mixer was tried out on a portion of the work in open cut and proved so successful, that it was used to line the tunnel portion, 1230 ft. long through solid rock. The lining is 8 inches thick at the invert and 18 inches thick at the crown. Concrete was conveyed a distance of 450 ft. with the best of results and the concrete placed in otherwise inaccessible positions. With this outfit about 11½ ft. of tunnel was lined per day on the average. Even with this comparatively rapid rate an excellent concrete was obtained, the quality of the mixture being very easily controlled. This perhaps is the largest piece of work to which the method of conveying concrete by compressed air has been applied.

CONCRETE WORK AT PANAMA.

The concrete handling plant used in building both Pedro Miguel and Miraflores Locks, consisted of four beam and four chamber cranes, which began work at Pedro Miguel in April 1910. At Miraflores the first concrete was poured with auxiliary equipment. The two beam cranes, which were erected originally at Miraflores were put in service in April of 1911 and those used at Pedro Miguel (two-beam and four chamber cranes) were moved to Miraflores one at a time, covering a period of about a year and were in full service on March 26, 1912.

During the construction of these locks some high records in mixing and placing were established which are as follows:

Concrete placed in one day.....	5,560 cu. yds.
Concrete placed in one week.....	26,959 cu. yds.
Concrete placed in one month.....	107,000 cu. yds.
Concrete placed in one year.....	934,410 cu. yds.

The highest record for concreting in wall forms by one beam crane was 962 cubic yards in 8 hours and 30 minutes, the highest hourly run being 160 cubic yards.

CONCRETE PLANT FOR BRIDGE WORK IN THE RENEWAL OF WOODEN TRESTLES WITH CONCRETE ARCHES AND FILLS.

R. P. Black, *Engineer Maintenance of Way.*

In the renewal of wooden trestle bridges with concrete arches, where the trestle is several hundred feet in length, a large amount of labor can be saved by taking advantage of the lay of the ground below the trestle for unloading the material and for the location of the concrete machine, mixer plant, and derrick.

In replacing a wooden trestle bridge of 211 ft. length, bed of creek 39 ft. below base of rail, with a concrete arch, the following equipment and location of plant, etc., was used. The concrete arch to be put in was of 12 ft. span, semi-circular, built of mass concrete sufficiently reinforced with one inch square twisted steel rods to prevent cracks due to uneven bearing of weights of fill, etc.

The abutments are set upon a paved concrete bottom placed on good earth foundation. The stream crossed is small, and not much trouble is experienced due to wash or change of creek bed. The solid floor paving is well protected at either end with concrete aprons put down to a depth of 8 ft., which will prevent undermining by any unforeseen current actions of the stream during high waters. The arch is built in sections 20 ft. in length with vertical joints, and independent of each other, to prevent cracking due to uneven settlement on the earth foundation.

The paving reinforcement is built up as that of a thick floor slab inverted, for the action of the weights on the abutments make an upward pressure on the paving, the reverse of that in a regular floor slab. 1,100 cubic yards of concrete was required for the arch.

A temporary track of 10-car capacity was constructed on the right-of-way north of the trestle for placing the material, such as cement, form lumber, reinforcing rods, etc., for unloading, also providing a place for the camp cars used by the construction gang.

The ground line at the north end of the trestle slopes gradually, and is about 15 ft. below grade till it gets within about 50 ft. of the creek, which was located close to the other end of the trestle. This permitted of a good material yard below the trestle for unloading crushed stone and sand. The concrete mixer was located near the edge of bench as close as practicable to the location of the arch, and out far enough from the trestle to permit of storage room under the trestle for the stone.

The stone was unloaded from drop bottom gondolas at the three bents opposite the mixer, and the sand next to the stone toward the end of the trestle. Before the sand and stone was unloaded, the space between the bents was paved with old car sides to permit of quick shoveling of the stone and sand when loading into barrows for the mixer.

The derrick was set up on a platform well supported by piling above the arch, and located just north of it. The top of the platform for supporting the mast was on the same level as the main track above the arch. The derrick used consists of a 60-ft. mast and a 50-ft. boom. The five guy wires from the spider of the mast were of sufficient length to give overhead room for the boom to make a complete revolution without fouling the guy wires. The hoisting engine for its operation was set back on the ground at north end of the bridge. By this means the derrick was operated without any interference whatever with the mixing plant. With the 50-ft. boom, and derrick being above track, concrete was taken from a batch holder of one cubic yard capacity at mixer, in a bucket, and placed in the forms at any point of the arch, whose barrel is 99 ft. long.

A 22 cu. ft. capacity Ransome concrete mixer on steel frame with wheels was used. The mixer is equipped with

a batch loader which is loaded at the ground level with wheelbarrows. The concrete is delivered from the mixer into a batch holder, from which it is taken by the bucket with derrick, or by wheelbarrows, to the forms.

The bucket used with this outfit, is a patent bottom derrick bucket, made by the Ohio Ceramic Company. The bottom of the bucket is narrow so the concrete can be delivered through a small space directly into the forms and has two pivoted gates that can be opened or shut at will, delivering all or part of its contents at any one time to the forms.

As a general proposition a wheelbarrow gang, in addition to the derrick, is kept supplying concrete to the forms, thereby permitting of the continuous operation of the mixer, the batch holder taking care of the extra batches that may be mixed between trips of wheelbarrows and derrick bucket. In designing the construction of the arch, the section was divided for taking care of each day's run of concrete, so the bridge will be made up of large monolithic blocks of masonry. These sections are so laid out that the joints between the monolithic blocks are at right angles to the resultant action of the stresses, due to the load on the arch. This construction, as far as possible, does away with the primary causes of failure in any respect, of the mass.

With this outfit it was possible to mix an average of 80 cu. yds. per day, and as high as 120 cu. yds. as a maximum mix.

In erecting this derrick, a track driver, driven by its own power was used to set up the derrick. The top of the leads of the pile driver are 36 ft. above the rail, therefore the mast, with aid of lines, was easily raised in place.

New Books

SIMPLIFIED FORMULAS AND TABLES FOR FLOORS, JOISTS AND BEAMS; Roofs, Rafters and Purlins. By Prof. N. Clifford Ricker. Cloth, 6x9 in.; 77 pages. Published by John Wiley & Sons, New York. Price, \$1.50.

A book written to aid the structural engineer and architectural designer in the rapid design of beams, joists, rafters, etc.; for simple cases of loading, with emphasis laid on the fact that such members must be designed for safety against excessive deflection as well as safety against rupture.

The author illustrates how inconvenient is the use of ordinary formulae for design of beams which readily explains the need of simplified formulae. The ordinary formulae are simplified by changing the expression of loads, fiber stress and modulus of elasticity from pound units to ton units; length to feet instead of inches and bending moments from inch-pounds to foot-tons. By these changes the numerical coefficients are smaller and more accurate results can be obtained by the use of slide rule or logarithms. The general treatment of the derivation of the simplified formulae for beams, joists, lintels, rafters, etc., is followed by a set of tables of formulae for all ordinary cases of beam flexure, which form the best part of the book. These tables include numerous formulae for cantilever and single span beams and joists with various conditions of end support and constraint for uniform and single concentrated loads producing maximum moments. The general formulae for moment of inertia, section modulus, load, safe length, deflection, maximum safe fiber stress and safe deflection are first given for each case and then for steel, cast iron and seven kinds of wooden beams with the proper constants introduced. Tables of moments of inertia and section moduli of rectangular beams and cast iron lintels follow. The book closes with a four-place logarithm table.

In the first part of the book a more complete explanation of the use of the tables would have added to the value of the work. The text is somewhat confusing in certain parts and contains several errors in theory as well as in typography which should

have been eliminated before publishing. The book, however, should prove of more than ordinary worth to the architect and structural engineer who must consider the matter of deflection in the design of beams.

PRINCIPLES OF INDUSTRIAL ORGANIZATION. Board, 6x8 in.; 270 pages, illustrated with organization charts, tables, etc. Published by McGraw-Hill Book Co., 239 W. 39th St., New York. Price, \$2.50.

The development of industrial institutions is treated in this volume, showing the effect of the development on the methods of organizing industrial forces. While dealing mainly with factory organization, the elementary principles are the same as those underlying railway organization, and the book is therefore of considerable interest to students of railway organization.

The predominant note throughout the text is the importance of the individual, and the effect of labor conditions on output, on home life, and through that the influence on the economic and national life.

Labor overseers have come to realize the importance of the laborer, and the fact that he must be handled as a fellow human being—must in general be led and not driven. Formerly humanitarian principles were frequently entirely disregarded in the relation between employer and employee. The book, therefore, emphasizes a development which has commanded marked attention in recent years. "Aside from all philanthropic ideas it is found that the physical care of men yields dividends."

There are fourteen chapters listed in the contents, each one of which is divided into numbered sub-topics (the latter is one of the excellent features of practically all new McGraw-Hill books). The subjects of the chapters are as follows: (1) Fundamental and Historical; (2) The Industrial Revolution; (3) The Effects of the Great Inventions; (4) Corrective Influences; (5) Modern Industrial Tendencies; (6) Forms of Industrial Ownership; (7) Principles of Organization—System; (8) Planning Departments; (9) Principles of Cost Keeping; (10) The Depreciation of Wasting Assets; (11) The Compensation of Labor; (12) Purchasing, Storing and Inspecting of Materials; (13) Location, Arrangement and Construction of Industrial Plants; (14) Resume—Theories of Management.

About the importance of cost keeping the author says: "It would seem to be unnecessary to urge the need of an accurate cost system for all industrial enterprises; yet, with the exception of simple processes, cost systems that give results approaching accuracy are not frequently encountered." The reasons for this are generally acknowledged to be the expense of securing the data. A little added expense would seem justifiable on many jobs on account of the value of such data in future work.

Little is said about trade unions or the change in the personnel of the laboring class, which is now composed mostly of immigrants from Southern Europe; the statement is made, however, that "Trade unionism in times past has suffered from lack of intelligent and honest leadership. If these defects could be remedied their usefulness would be greatly increased. * * *"

Immigrant labor was formerly treated with contempt by probably the majority of employers. This feeling is now greatly abated, but the influx of foreign immigrants undoubtedly cheapened labor temporarily, and drove many men to more genteel, though many times less remunerative positions.

DESIGN OF PLATE GIRDERS. By Lewis E. Moore. Cloth, 6x9 in.; 285 pages, 40 tables, numerous text illustrations. Published by The McGraw-Hill Book Co., New York. Price \$3.00.

A new book on the design of plate girders, which now form a goodly portion of the structural steel work done in this country, filling a long felt want in a most commendable manner. Most books on the subject of bridge and structural designs deal with very little else than more or less exact directions as to how to attain a certain result, and do not discuss the applicability or limitations of any of the given rules for any particular case.

Theoretical considerations in general receive the greatest emphasis in such books, with the result that practical points so important for economical fabrication are almost wholly ignored.

In this book the aim has been to explain clearly and in detail the reasons underlying designing, showing the assumptions made and presenting alternative methods so that the young designer and student will have an opportunity to develop an ability to choose the most suitable method for the case in hand. If more of our text and reference books were written with this idea in mind, the tendency toward a "blind copying" of details, so prevalent would be eliminated.

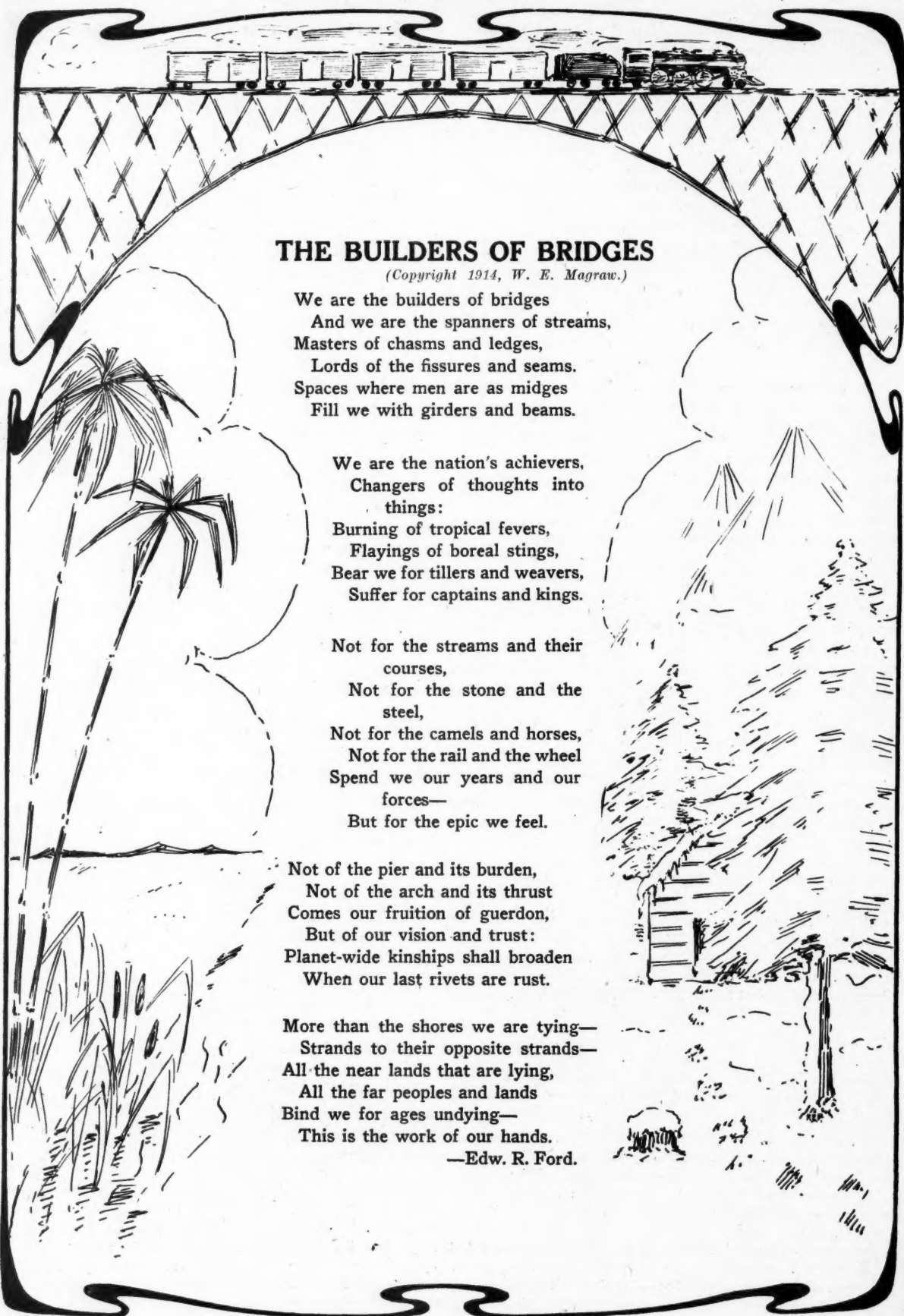
The first three chapters treat of: Stresses in plate girders; rivets; and theory of plate girders. On account of the great amount already written concerning stresses this chapter is reduced as much as possible. The subject of rivets is treated in a somewhat different manner than is usually the case in treatises on structural design. The chapter on theory is a valuable one containing besides the general theory some interesting data and formulae on stiffness and deflection. The matter of web splices is insufficiently treated and is the one weakness of the book, only one method of web splicing being described and illustrated. Chapters 4, 5 and 6 give detailed designs of: a through plate girder; deck plate girder and a box girder, with a careful discussion of each point which arises in design. The through and deck girder designs are based on specifications of the N. Y., N. H. & H. R. R. R. given at the back of the book. These specifications are the same as those adopted by the Amer. Ry. Engr. Ass'n., except in a few minor points, such as: allowable compression, which is given as 13,500 lbs. per sq. in., as against 14,000 lbs. per sq. in. in the latter; provision is made for corrosion of metal and the camber for girders of over 50. ft span is $\frac{1}{8}$ in. per 15 ft. instead of per 10 ft. as in the A. R. E. A. specifications. Box girders being limited to use in buildings the illustrative examples are designed for fixed loads only and no particular specifications are used. Chapter 7, Shop Hints for Structural Draftsmen, by John C. Moses, M. Am. Soc. C. E., is one of the most valuable in the book. It is absolutely necessary in order to turn out economical designs that the designer should be entirely familiar with shop methods. This chapter supplies this information in an interesting manner. The set of 40 tables at the back of the book, should prove of great value to the practicing engineer when designing plate girders. These tables include: Cooper's E-60 moment diagram; tables of web, flange and cover plate areas, and moments of inertia; diagrams for stiffener spacing according to different formulae, and tables of rivet values and rivet spacing and clearances. The arrangement of subject matter and tables and the typography are of the very best.

Mr. Moore is to be congratulated on having produced such a commendable work for which there always has been an unsupplied demand. It should have a place in every student's and practicing engineer's library.

INSPECTION OF THE KEY WEST CONCRETE ARCH VIADUCT.

The annual inspection of the 13 miles of concrete arch viaduct on the Key West extension of the Florida East Coast Railway has just been made. This inspection includes foundations and piers, and according to the report of inspecting engineer, Mr. W. J. Krome, no deterioration due to pounding of waves or action of salt water was found. The inspection of the portions below water was made by divers.

It is of interest to note that bids were recently taken by the city of Baltimore, Md., for placing of reinforced concrete covering over floor beams, stringers and main members of the south and viaduct spans of the Calvert street bridge over the tracks of the Northern Central R. R. Co., to prevent further corrosion of steel by locomotive gases.



THE BUILDERS OF BRIDGES

(Copyright 1914, W. E. Magraw.)

We are the builders of bridges
And we are the spanners of streams,
Masters of chasms and ledges,
Lords of the fissures and seams.
Spaces where men are as midges
Fill we with girders and beams.

We are the nation's achievers,
Changers of thoughts into
things:

Burning of tropical fevers,
Playings of boreal stings,
Bear we for tillers and weavers,
Suffer for captains and kings.

Not for the streams and their
courses,

Not for the stone and the
steel,

Not for the camels and horses,
Not for the rail and the wheel
Spend we our years and our
forces—

But for the epic we feel.

Not of the pier and its burden,
Not of the arch and its thrust
Comes our fruition of guerdon,
But of our vision and trust:
Planet-wide kinships shall broaden
When our last rivets are rust.

More than the shores we are tying—
Strands to their opposite strands—
All the near lands that are lying,
All the far peoples and lands
Bind we for ages undying—
This is the work of our hands.

—Edw. R. Ford.

The Signal Department

SIGNAL STANDARDS, MISSOURI PACIFIC RAILWAY.

The several diagrams which follow are typical of many signal installations on the Missouri Pacific Ry.

Semaphore Blades.

All semaphore signal blades, except dwarf signals, are made of well seasoned ash. The shapes and sizes of the various blades are shown. "A" shows the home blade, "B" the distant blade, "C" the dwarf blade, "D" the train order (Horrington) and block signal blade.

The face of the home signal blade is painted red with a white stripe, parallel to the outer end, one-eighth of the length of the blade in width and one-fifth of its length from the outer end. The backs of all blades are white.

The face of the distant signal blade is painted yellow, a light chrome yellow paint being used. A black stripe is painted, parallel to the outer end of the blade, one-eighth of the blade's length in width and one-fifth of its length from the outer end. The painting of the dwarf signal blade is the same as for the home blade except for the width and location of the strip (see illustration for dwarf blade). All blades are varnished with one coat of finishing varnish.

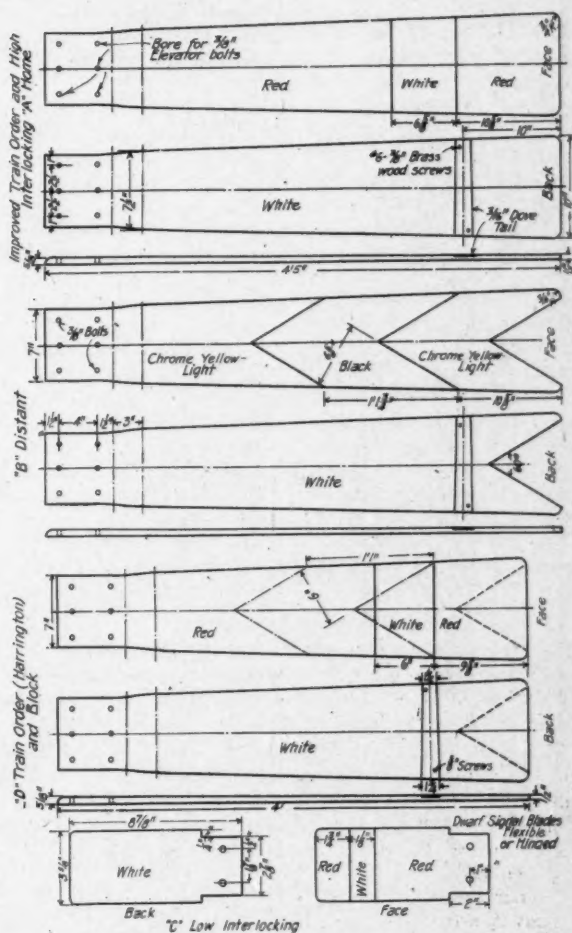
The night color indications are: Clear, green; caution, yellow; stop, red.

Painting of Signal Masts and Cases.

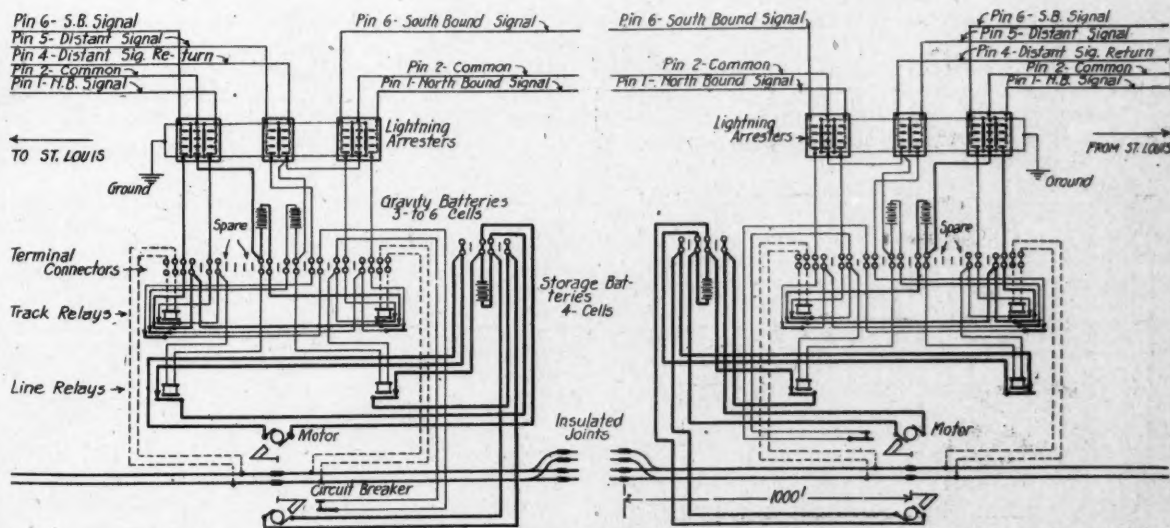
All signal masts are painted white except the section from the ground to a point six feet above base of rail. This section is painted black. On signal masts where the mechanism case is at the bottom of the post, the part painted black does not extend above the mechanism case. All fittings are painted black.

Boot Leg.

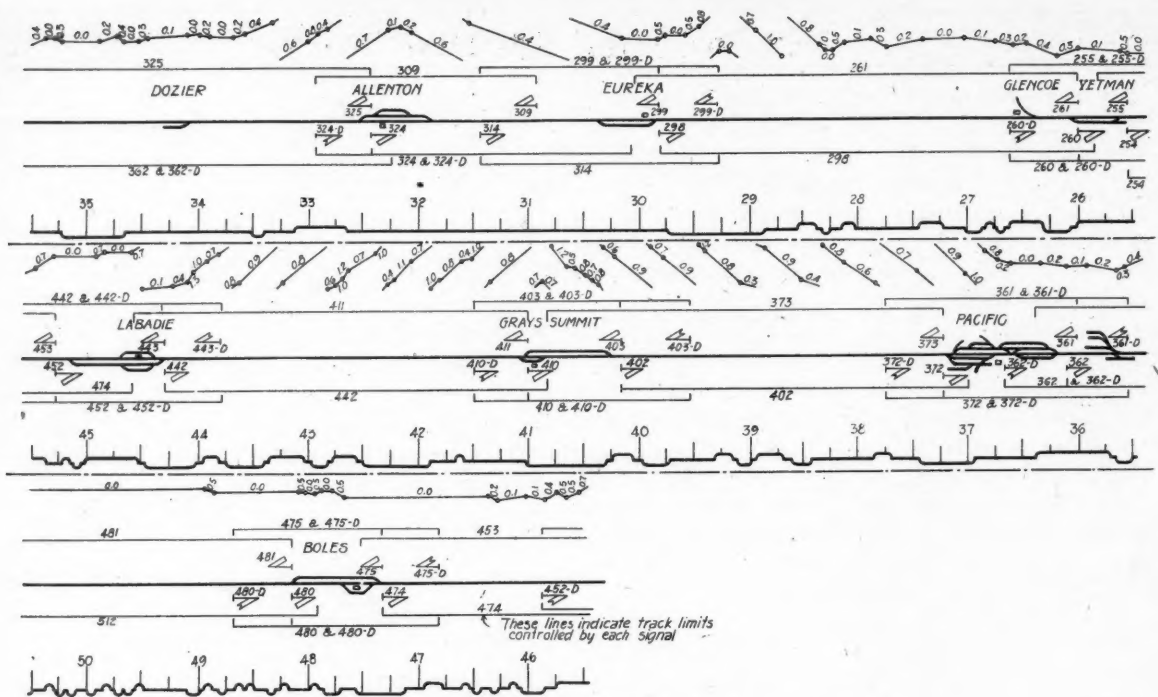
The boot leg is made as follows: A piece of trunking ten inches long is cut at an angle so that the depth of the groove at one end is equal to zero and at the other end the same as its depth in the original piece of trunking. This cut piece when finished is fastened to the top of the ground trunking, with the groove turned down, over an opening in the capping of the ground trunk-



Semaphore Signal Blades.



Typical Wiring Diagram for Signals at Ends of Passing Tracks.



Profile and Location Chart for Automatic Signals on Single Track.

ing, at a point about six inches from the rail. The end of cut piece of trunking nearest to the rail when fastened in place should be about two inches away from the rail, and the highest point not more than one inch above the base of the rail.

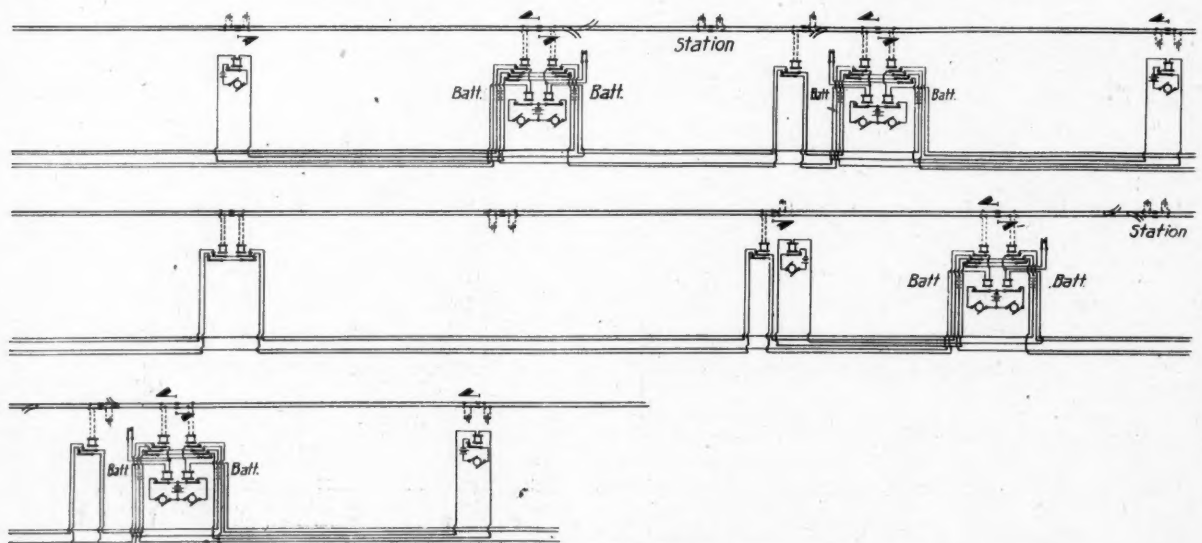
The track wire in the trunking, which is No. 10 B. & S. copper, forms a double loop before leaving the trunking to be spliced to the No. 8 galvanized iron bond wire, which forms the final track connection. The double loop allows plenty of slack wire for repair in case of a broken joint or in case the tracks or trunking are shifted.

After the wires are spliced the joint is treated as follows: Joint is well riveted with solder, then painted with one coat of P. & B. insulating compound and wrapped with one layer of Okonite tape; this to be painted with one coat of P. & B. insulating compound and then wrapped with one layer of friction tape and painted with one coat of P. & B. insulating compound.

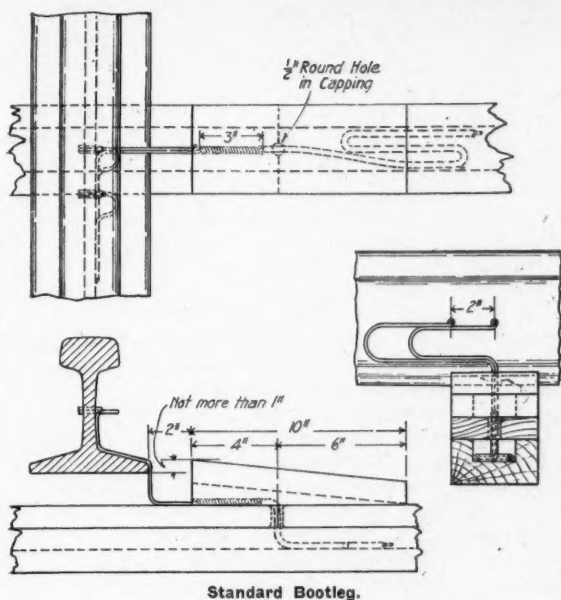
Automatic Block Signals on Single Track.

The profile and location chart for signals on single track, as shown, is typical of many installations.

The control limits of the signals are shown by the length of the lines drawn parallel to the track. Each line bears the number of the signal or signals which protect the track within the limits of the line. For example: Signal No. 411, which is the outbound signal at station "Grays Summit," protects the portion of track within the limits of line No. 411. The extent of the protection, as shown, is from signal No. 411 to station "Labadie." In like manner the opposing signal, No. 442 outbound at "Labadie," protects that portion of track between signal No. 422 and station "Grays Summit." At stations, the inbound home and distant signals protect that portion of track up to the opposing inbound distant signal. For example: Signals No. 403 and 403D protect the track between these signals and signal 410D.



Typical Circuits for Automatic Signals on Single Track.



Standard Bootleg.

The circuits and wiring diagram are typical for the signals shown on the location chart. Note that line battery is independent from signal operating battery and that there is a separate common wire for each direction, also that switch indicators are not used.

We are indebted to Mr. B. H. Mann, signal engineer of the Missouri Pacific Ry., for the information and plans used herein.

Personals

Although we are publishing monthly in these columns a practically complete report of all appointments of interest to our readers, it is probable that this information could be published earlier if each subscriber would make it his business to notify us of new appointments immediately. We request and we shall appreciate your assistance in this respect.

KARL HANSON has been appointed signal foreman of the *Atchison, Topeka & Santa Fe Ry.* at Chanute, Kan., succeeding J. W. JOHNSON.

H. D. CARROLL has been appointed signal supervisor of the *Baltimore & Ohio R. R.* at New Castle Jct., Pa., succeeding JAMES CAIN. E. W. DORSEY has been appointed signal supervisor at Newark, O., succeeding W. D. CARROLL.

R. A. SHEETS has been appointed signal inspector of the *Chicago & North Western Ry.* at Chicago, Ill., succeeding H. F. MOCK.

R. F. TYLER, formerly signal inspector, has been appointed signal supervisor of the *Chicago, Milwaukee & St. Paul Ry.* at Tacoma, Wash. He succeeds N. J. WESTERMARK, appointed construction foreman. These appointments are on account of temporary curtailment of forces.

J. L. MARCUM has been appointed signal supervisor of the *Missouri Pacific Ry.*, office at McGehee, Ark., succeeding CLYDE ODELL.

J. C. O'BRIEN has been appointed signal supervisor of the *New York, New Haven & Hartford R. R.* at New Haven, Conn.

W. H. FENLEY, formerly signal engineer, has been appointed superintendent of telephones and telegraphs of the *Panama R. R.*, office at Colon, Panama.

THORN BIRDSEYE has been appointed assistant supervisor of signals of the *Pennsylvania R. R.*, at Baltimore, Md. A. H.

TASKER has been appointed assistant supervisor of signals at Camden, N. J. He succeeds C. C. THORN, appointed assistant supervisor of signals of the Pittsburgh division at Johnstown, Pa., succeeding P. B. SMITH, promoted.

RULES GOVERNING THE CONSTRUCTION, MAINTENANCE AND OPERATION OF INTERLOCKING PLANTS.

For several years past the Railroad Commission of Wisconsin has been working in conjunction with the Railroad and Warehouse Commission of Illinois, the Railroad & Warehouse Commission of Minnesota and the Railroad Commission (now Public Service Commission) of Indiana, for a uniform set of rules governing the construction, maintenance and operation of interlocking plants on steam and electric railways. Several conferences have been held at various times at which the signal engineers of practically all the railroads interested in signaling in these four states have been present. It is estimated that one-third of the total mileage of steam railroads as well as a large share of the mileage of electric railways in the United States has been represented at these conferences. The engineers of the commissions have held several conferences independently of those held with the signal engineers of the railroads, and as a result a set of rules has been prepared which the engineers of these four commissions have agreed upon for submission to their respective commissions for adoption. Accordingly these rules were submitted to the Wisconsin commission and, after a public hearing, were adopted on October 8, to become effective December 1, 1913. A copy of these rules follow herewith.

Preliminary Requirements.

Section 1.—Indications and Aspects: (a) As far as practicable, a uniform system of indications and aspects must be used for each operating division. When requested every railroad company operating in this state shall submit plans to the commission showing the system of indications and aspects in use, or which it proposes to use for fixed signaling for each operating division. (b) If changes are made by any railroad company in its system of signal indications and aspects on any operating division in this state subsequent to the filing of plans, it shall notify the commission accordingly.

Section 2.—Plans to be Submitted: (a) Prior to the construction, reconstruction or rehabilitation of any interlocking plant, there shall be filed with the commission as a basis for approval, the following plans: (b) A station map or other plat, drawn to scale, showing all tracks, bridges, buildings, water tanks, and other physical surroundings located on the right-of-way of each company. (c) Profiles showing the grade of each railroad company's main tracks for a distance of not less than two (2) miles in each direction from the crossing or junction. (d) A track plan in duplicate (and as many more as the roads desire approved) showing the location of all interlocking units, the tower and its general dimensions, and any other appurtenances necessary to show a complete layout of the proposed interlocking plant. When not expedient to locate accurately all physical characteristics by figures, they should be established by scaled distances within the interlocking limits hereinafter specified. (e) When merely changes and additions are involved, no station maps or profiles need be filed with the track plans except when requested by the commission. (f) All plans filed with the commission under this and other sections must be of light weight paper when in the form of blue prints.

Section 3.—Symbols: In the preparation of plans, the symbols approved by the Railway Signal Association shall be used to indicate switches, derails, signals and other essential parts of the interlocking plant.

Section 4.—Limits of Interlocking Plants: The interlocking limits are defined by the home or dwarf signals situate on any specified track and located farthest from the point to be protected. Any appliances operated in conjunction with the interlocking plant, and situated beyond the limits herein designated, are considered as auxiliaries.

Section 5.—Approval of Plans: (a) When possible, the railway companies concerned should agree on the plans before submitting them to the commission. (b) If the preliminary plans are satisfactory, or if in the judgment of the commission modifications are necessary, the plans will be approved accordingly. Of the plans so approved, one copy will be retained by the commission, and the duplicate returned to the petitioning company. (c) The approval herein described will stand for a period of one year. If the work is not commenced within that period, a new approval must be obtained.

Section 6.—Physical Changes, Reconstruction and Rehabilitation: No interlocking plant shall be reconstructed or rehabilitated, nor shall any change be made in the locking or in the location of any unit, until plans have first been submitted to and approved by the commission.

Section 7.—Conditional Service: (a) Upon the completion of any work on any interlocking plants which involves changes in the locking, the units must be connected and adjusted, the plant placed in conditional service for not less than twenty-four (24) hours, and remain so until relieved by order of the commission. (b) When minor changes are made in locking under plans previously approved by the commission, it will not be necessary to place the plant in conditional service prior to the time it is ready for inspection; and in cases when permission is received from the commission in advance, the plant may be placed in full operation, if the commission is unable to inspect it within twenty-four (24) hours after it is ready for inspection. (c) Conditional service is hereby interpreted to mean that all units and other apparatus involved be connected and operated from the interlocking machine in the tower. All trains shall come to a stop at the governing home or dwarf signal regardless of its position and that such signal shall not be operated to give a proceed indication until after the train has made the prescribed stop.

Section 8.—Petition for Inspection: (a) Prior to or accompanying the petition for inspection of completed interlocking plants, the following detailed plans will be required: (b) A track plan similar to the one referred to in Section 2, showing all tracks and interlocking units as actually constructed, the terminal ends of each track to be numbered or lettered for use in connection with the manipulation sheet. A locking sheet and dog chart showing the arrangement of locking in the machine as installed; wiring plans showing in detail all circuits used in connection with the plant; a manipulation sheet with or without track diagrams as required by the commission, showing in tabulated form the numbers of all levers necessary to be manipulated for any given route designated on the track plan. (c) A suitable framed manipulation chart and track diagram shall be properly placed in the interlocking tower. The terminal ends of each track on this chart shall be numbered or lettered to correspond with the track plans above mentioned. (d) The petition for inspection of any interlocking plant, when possible, shall give three (3) days notice in advance of the time when the plant will be ready for inspection. Upon receipt of such notice, the commission will endeavor to have the plant inspected within three (3) days after receiving such advice. If the commission is not able to make the inspection within the time specified, it will authorize the railroad company in charge to place the plant in full operation, subject to future inspection. (e) If upon the inspection of any interlocking plant by the commission, it is found to be installed in accordance with the approved plans, a temporary permit will be issued to the railroad company in charge, pending the issuance of formal permits.

Requisites of Installation.

Section 9.—Type of Signals: (a) Except when approved by the commission, all interlocking signals must be of the semaphore type. The apparatus connected with the operation of these signals must be so constructed that the failure of any part directly controlling the signal will cause it to display its least favorable indication. (b) Semaphore arms must display indications to the right of the signal post, except where the physical conditions on a road require the display of signal indications to the left.

Section 10.—Location of Signals: (a) All fixed signals must be located either over or upon the right and next to the track over which train movements are governed, except on roads operating trains with the current of traffic to the left, or where physical conditions require placing the signals to the left of the track. (b) Bracket post signals may be used on roads operating trains over two (2) or more tracks in the same direction, when such practice is uniform for any specified operation division, or where local conditions require their use.

Section 11.—Locking of Signals: The locking between the levers of the interlocking machine must be arranged so that a home or dwarf signal cannot be cleared for any given route unless all switches, derails, movable point frogs and other units in the route are in proper position and locked.

Section 12.—Home Signals: (a) When required by the commission, all home signals must be equipped with not less than two arms. Unless operated by power all home signals in mechanical plants must be pipe connected, except when otherwise approved by the commission. (b) When used in connection with automatic train stopping devices, the home signal may be located immediately opposite the means for controlling the apparatus of the train stopping device. (c) When used in connection with derails and other units the home signal must be located as far in advance of such units as is necessary to secure full protection, but in no case shall it be less than five (5) feet in advance of such units. (d) When home signals are semi-automatic, or form a part of an automatic block signal system, calling-on-arms or some other means may be used for advancing trains. (e) All high speed signals located in automatic block signal territory shall be semi-automatic and form a part of the block signal system.

Section 13.—Dwarf Signals: Dwarf signals indicate slow speed movements and may be used to govern train movements on all tracks other than main tracks, except as hereinafter specified; on main tracks to govern train movements against current of traffic, and when approved by the commission as intervening signals to facilitate switching movements. When used they must be located and connected in the same manner as home signals.

Section 14.—Advance Signals: Advance signals may be used when necessary, and must be installed in the same manner as home signals.

Section 15.—Distant Signals: (a) On level and ascending grades, distant signals shall be located not less than two thousand five hundred (2,500) feet in advance of their respective home signals. On descending grades the minimum distance of two thousand five hundred (2,500) feet shall be increased at the rate of one hundred (100) feet for each one-tenth (1/10th) of one per cent of gradient. (b) Where conditions justify, the location and character of distant signals or the method of operation may be varied or the signals be omitted, depending upon the conditions surrounding each particular case. (c) Except as hereinafter provided, all high speed tracks must be equipped with power-operated distant signals having electric locks or other suitable apparatus to prevent changing of the route until such signals have indicated their normal position. (d) When required by the commission, distant signals shall be so arranged as automatically to indicate stop when the track between the home and distant signal is occupied, or when any intervening switch is not in its normal position.

Section 16.—Switches: All switches, derails, movable point frogs and other units within the interlocking limits hereinbefore defined, must be incorporated in the plant.

Section 17.—Derails on Steam Roads: (a) Main Tracks: On level grades facing derails must be located not less than five hundred (500) feet from a drawbridge or the fouling point of a crossing or junction. On descending grades facing derails must be located to give practically the same measure of protection as for level grades, and the minimum distance of five hundred (500) feet must be increased at the rate of ten (10) feet for each one-tenth (1/10th) of one percent gradient. On ascending grades the minimum distance of five hundred (500) feet may be reduced

at the rate of ten (10) feet for each one-tenth of one percent gradient; but in no case shall such derails be located less than four hundred (400) feet from a drawbridge or the fouling point of a crossing or junction. (b) Pocket derails: Where such are used, they shall be located so as to derail the first pair of wheels on the ties at a point not less than fifty (50) feet from the fouling point of a crossing or junction. (c) Backup Derails: These shall be placed not less than two hundred fifty (250) feet from a drawbridge or the fouling point of a crossing or junction. (d) Secondary Tracks: All tracks other than main tracks shall be termed secondary tracks. On such tracks derails shall be placed not less than two hundred (200) feet from a drawbridge or from the fouling point of a crossing; and not less than fifty (50) feet from the fouling point of a junction. (e) The fouling point is where two trains moving toward a common center would come in contact. (f) Where conditions justify, the location of derails may be varied or they may be omitted, when approved by the commission.

Section 18.—Derails on Electric Roads: The location of derails on electric roads shall be determined in the same manner as for steam roads. In placing derails in the tracks of such roads, consideration will be given to speed and character of traffic.

Section 19.—Type of Derails: Derails must be of an approved pattern, suitable for the purposes intended, and so placed with reference to curvature, bridges and other tracks as to secure a maximum of efficiency and safety.

Section 20.—Guard Rails: Where physical conditions require their use, guard rails shall be installed in connection with derails. When used, they shall be placed between the track rails, parallel to and not less than ten (10) inches distant in the clear therefrom, and must be of sufficient height, length and strength, and be properly secured to the track ties.

Section 21.—Automatic Train Control: Automatic train stopping devices which are a part of a system of automatic train control approved by the commission, may be used in lieu of derails. In such devices, the means for automatically applying the train brakes shall be located a sufficient distance in advance of the fouling point as to insure a safe breaking distance.

Section 22.—Locks: (a) In mechanical plants all facing switches, split point derails in main tracks and all slip switches and movable point frogs, must be locked with facing point locks. All other derails, switches and other units must be locked, either with facing point locks or with switch and lock movements. (b) In plants equipped with mechanical signals, all derails must be provided with bolt locks; also all switches, movable point frogs and other units, where conditions require them. (c) In power plants, the arrangement must be such that the signals operating in connection with derails, facing point switches and other units cannot be operated unless these units are in proper position.

Section 23.—Detector Bars: (a) Unless otherwise provided, all derails, switches, movable point frogs and other units shall be equipped with detector bars of approved design not less than fifty three (53) feet in length, or longer if required. (b) Except as hereinafter provided, all crossings shall be equipped with detector bars of suitable length, so interlocked as to insure a clear crossing before an opposing route can be set up or a proceed signal given. (c) Crossing detector bars will not be required where electric locking is installed; nor at outlying crossings of simple character where no switching is performed, when the plant is equipped with time locks.

Section 24.—Time Locks: Unless equipped with electric locking, time locks must be installed to prevent the changing of high speed routes, until after the home signal has displayed the stop indication a predetermined time.

Section 25.—Electric Locking: Electric locking may be provided in place of time locks and crossing bars. When used, the circuits must be arranged so as to prevent the changing of a route until the train has passed through the interlocking limits or through a predetermined part of the plant.

Section 26.—Detector Circuits: When a railway company is

equipped with sufficient maintenance forces for properly maintaining electric detector circuits, such circuits may be used in place of mechanical detector bars.

Section 27.—Machines: (a) All mechanical interlocking machines shall be equipped with locking of the preliminary type. (b) All power interlocking machines shall have the locking so arranged as to be effective before the operating conditions of any circuit directly controlling a unit can be changed. Suitable indicating and locking apparatus shall be provided to prevent the placing of a lever in complete normal or reverse position until the unit controlled has completed the intended operation, except that signals shall indicate the normal position only.

Section 28.—Locking of Levers: (a) The locking must be so arranged that conflicting routes cannot be given at any stage in the setting up of a route, nor a proceed indication given until all switches, derails, movable point frogs, facing point locks and other units in the route affected are in proper position. (b) When a separate level is used to operate distant signals the locking between the home and distant signals shall be so arranged as to prevent the distant signals from giving the proceed indication until the home signals operating in connection with such distant signals are in the proceed position.

Section 29.—Locks and Seals: (a) All interlocking machines must, when practicable, be provided with means for locking or sealing the mechanical locking and indication apparatus in such a manner as to prevent access to any except authorized employees. (b) All power interlocking cabinets, time locks, time releases, emergency switches, indicator and relay cases must be provided with suitable covers and fastenings and be properly sealed or locked, and must not be opened by any but authorized employees.

Section 30.—Cross Protection: (a) As far as practicable, cross protection apparatus must be provided in connection with electric interlocking plants to prevent the operation of any unit by cross or grounds. (b) Low voltage circuits, as far as practicable, must be designed to prevent the operation of apparatus by cross or grounds.

Section 31.—Annunciators: When operating conditions require annunciators, they shall be installed.

Section 32.—Signal Towers: (a) Signal towers shall be so placed and be of such height and size as to best serve the purpose for which they are intended. (b) The use of interlocking towers for purposes other than interlocking, dispatching and block work is undesirable. (c) If work other than interlocking is carried on in the tower, a suitable partition or railing must be provided to prevent outsiders from having access to interlocking apparatus, and interfering with the duties of the operator or towerman.

Section 33.—Tower Lights: The tower lights must be screened off so that they cannot be mistaken for signals exhibited to control train movements.

Section 34.—Material and Workmanship: Materials and workmanship must be first-class throughout. When complete, the interlocking plant must be in every way suitable and sufficient for the purposes intended.

Maintenance and Operation.

Section 35.—Maintenance and Operation: (a) Interlocking plants must at all times be properly maintained and efficiently operated. Any rules or regulations that the railway companies may have adopted for the guidance of employees in operating and maintaining interlocking plants must be appropriately framed and conveniently placed in interlocking towers. (b) When an interlocking plant is taken out of service the commission must be notified immediately. Under such circumstances train movements must not be governed by interlocking signals but by the usual precautions prescribed by statute governing train movements over and across railroad grade crossings, junctions and drawbridges.

Section 36.—Interlocking Reports: Reports for each interlocking plant shall be filed with the commission by each railroad company concerned, which reports must be filed in manner and form prescribed by the commission.

The Maintenance of Way Department

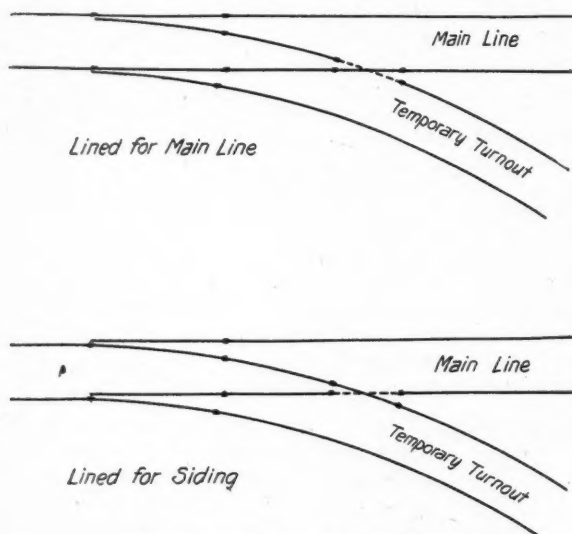
CONSTRUCTING AND USING TEMPORARY TURNOUTS WITHOUT FROGS AND SWITCHES.

By Andrew Palm, Roadmaster, C. C. T. Co.

In the temporary track lay-out which I am submitting here-with I wish to show how we construct turnout to temporary tracks for storing cars of material for washout purposes near the places where we expect washouts are likely to occur.

This is nothing more than the old stub switch method with the frog and guard rails omitted.

We all know that it is undesirable to place in main lines any switches that are not absolutely necessary, so quite frequently I lay one of these temporary turnouts in preference to the standard switch and frog turnouts. From a safety standpoint,



Turnout Without Frog or Points.

they are ideal, and can be constructed for less than half the cost of the standard point switch.

Our main lines are laid "broken joints" and when we decide to lay a track of this character we take two half rails, using one to even the joints at the point where we wish to begin our turnout and the other where the frog would be placed in a standard lead; this half rail is used in place of the frog when we desire to place on or take cars from the temporary siding, by simply releasing the half rail from the main line and laying it in the open space in the turnout, and when the cars have been taken out or placed in, the rail is taken up and relaid in the main line at the beginning of the turnout; all that is necessary is to remove the angle bars from the main line and a few spikes from the inside of one rail, and the same amount of spikes from the outside of the rail opposite back of the joints; where this connection is to be made with the turnout; by using the angle bars to make this connection there is no likelihood of a derailment, while there would be if the joints were left open as they were in the days when stub-switches were in vogue.

I prefer this method for "spurring out" extra gang outfits to the old way; digging out between the ties for three rail lengths, then opening the main line and lining the main track out to connect with the temporary spur. This I consider bad practice, as the roadbed is badly disturbed, ties are skewed,

which renders it necessary to re-space the ties and to correct the gauge of the main line rails after each time the track has been "cut."

By the method which I am submitting, the roadbed is disturbed but very little, the ties not at all, for cross-ties are inserted between those in the main line to support the lead rails.

I also prefer using this "layout" instead of tracks with standard turnouts for temporary use by extra gang outfit cars, for we then have the cars isolated, and switchmen and trainmen cannot use the track for storing or setting out commercial cars.

We continually have complaints from extra gang foremen as to the rough usage their outfits are receiving at night by cars being "kicked in" against them. The trainmen in explanation of the rough usage given the outfit cars, almost invariably state that it is a misjudgment of distance on account of the darkness, but as we are using foreign labor very many of the occurrences are traced to racial prejudice on the part of the trainmen; it is quite discouraging to the foreman who is using every effort to get a fair day's work from these laborers to have them maliciously bruised by a trainman who is devoid of principle.

In the construction of new railroads we find this "layout" very useful; often we have to construct sidings for track-laying and surfacing gangs, and more often than otherwise we are short of frogs and switches; we lay these sidings at points where permanent sidings are to be located, and later, upon the arrival of the frogs and switches, the standard turnouts are installed.

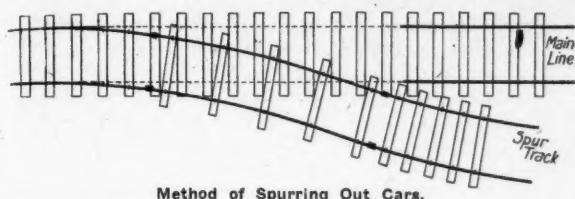
Our switch leads are for a No. 10 frog, whose length is 16½ feet, or half the length of a 33-foot rail, so when we "square" the joints for the temporary turnouts we have done that much toward the installation of the permanent switches.

Unless we used this temporary lead, we would often be compelled to have our material trains go fifteen to twenty miles to pass each other; we can pass the trains by switching the empty train onto one of these sidings and thereby allow the loaded train to proceed to the front, resulting in the saving of many hours of valuable time. We have passed these trains with only two trackmen, an assistant foreman and one laborer making the necessary changes.

The above is an unusually clever idea for a turnout without frog or points; or where occasional use develops for a turnout, not sufficient to justify the installation of a permanent turnout, even if frog and point were available.

The writer was once instructed to spur out one car, an outfit for eight foreigners, using the ordinary method of stripping out and lining over the track. On investigation the ties in the main track were found to be so rotten that they would have been entirely useless after having been dug out, lined over, and lined back again. This, of course, was not on a very important track. The construction forces naturally would not care to renew the ties for 60 feet of track, just to spur out a single car. And the ties, if undisturbed, had a year or more life in them.

The sketch herewith shows the method pursued. The spikes were pulled from the rails, and the rails lined over, connected to the temporary track with angle bars, and spiked to gauge. Enough short ties were laced-in to hold the track to gauge.



Method of Spurring Out Cars.

In any case where the lined over track is left at a pretty sharp curve, the locomotive should not be pushed in on the curve. The best arrangement is to have a number of empty flats between the car or cars to be spurred out and the locomotive. In this way the light empty flat cars will pass over the track without spreading it or getting off the track as a locomotive is apt to.

With a well trained and organized gang three or four cars may be spurred out in this way and the track closed in ten minutes, after thorough preliminary preparations have been made. [Editor.]

ANNUAL TRACK INSPECTION, N. Y. C. & H. R. R. R.

In accordance with its usual custom, the New York Central & Hudson River R. R. on Nov. 15, made its annual track inspection and awarded prizes to 53 foremen.

Material improvements have been made in the tracks during the past year, but it is stated that further improvement is possible by devoting particular attention to the systematic method of work on sections.

Premiums were awarded on the Main Line and West Shore by an inspection made by the main committee and upon other lines by sub-committees.

The prizes for Main Line and Yard sections are \$3.00 per month, and for Branch Line sections are \$2.00 per month. The foreman having the best section on each division (except the electric division) receives an additional premium of \$2.00 per month, making a total of \$5.00 per month. Following are the foremen to whom prizes were awarded:

Main Line Division.		
Division.	Sub-Div. Section.	Foreman.
Electric	A 8	Pietro Matzell
	B 6	Joe Masulla
Eastern	1 3	Richard Dourney
	3 15	J. F. Torpey
	3 5	John Andros
	4 14	Carmen Patsey
Mohawk	5 7	Joseph Harris
	6 19	George Shuster
	7 19	John Dinneen
	22 8	Antonio Barry
Western	22 20	Cesare Mazzolli
	10 8	Patrick Fitzgerald
	10 27	C. J. Farnam
	11 17	Michael Delayney
Rochester	13 1	John Nick
	23 2	John Sheridan
	12 4	Adelbert Foster
Ontario	14 26	Frank Ross
	15 4	James H. Riley
	16 20	Alexander Woodside
St. Lawrence	16 21	Dennis O. Sullivan
	17 2	Michael Tauroney
	18 10	Arduino Frasco
Adirondack	19 2	Charles Pooler
	8 11	Nazzareno Botticelli
	9 11	James H. Malley
	9 1	Moses Duquette

River	20 5	Peter Duane
	21 4	W. D. Burger
	24 20	Fred H. Pruden
	25 13	John Fave
Pennsylvania	26 17	Joseph Nelson
	27 7	Manuel Teats
	28 2	O. R. Pearson

Branch Lines.

Division.	Sub-Div.	Section.	Foreman.
Eastern	2-A	8, Milwood	John Brannigan
Mohawk	5	19, Iron Works	Frank Pratt
Western	10	25, Jordan	Richard McPeak
Western	13	31, No. Towanda	William McCarthy
Rochester	12	21, Caledonia	James Cunningham
St. Lawrence	18	18, Edwards	Geo. Morrow
River	21	7, Kingston	John O'Brien
Pennsylvania	25	6, Wellsboro	Joseph Glass
Pennsylvania	27	16, Madera	Pietro Zito

Yards.

Division.	Sub-Division	Foreman.
Eastern	2, 30th St., N. Y. City	Thos. Cliggett, Sr.
Mohawk	15, W. Albany	Joseph Lewis
Mohawk	16, Karner	William Brennan
Western	29, DeWitt	Frank Cook
Western	24, Bailey Av., Buffalo	August Adamski
Rochester	6, Rochester	James Flynn
Ontario	21, Rome	A. D. Butts
St. Lawrence	1-A, Watertown	Donetti Tauroney
River	2, Weehawken	Thomas Griffin
Pennsylvania	11, Clearfield	Andrew J. Johnson

Some sections were excluded from premiums on account of having had extra gang work, foreman absent or other work, or new foreman.

Correspondence

ANNUAL INSPECTIONS.

Editor Railway Engineering: One of the great events of the railroad year is the annual inspection. It surely puts everybody, every interested man, on his mettle to win the prize. Incidentally, getting ready for the annual inspection costs the companies a neat sum of money, and the results very often create ill feeling and hatred among the employees. The writer has watched the working of this fiasco for a great many years, and long ago came to the conclusion that it was not the best way to create dividends. He has in mind at this time one of the cleverest railroad officials in the United States, a man who has worked his way from the bottom to the very top of the ladder, who is a firm believer in this annual spectacular display.

Perhaps if he could see some of the things that have taken place after the first underground message was sent out stating that the annual inspection would come off about such a time, he would make some changes or modifications. He would see section men, shopmen and other employees called off from their regular duties and ordered to get ready for the annual inspection, with the threat that the superintendent would fire anybody who gave the officials an opportunity to make unfavorable comments, as "Mr. ——" wanted to be credited with having the best division on the system.

The aforementioned gentleman has a habit of starting out on one of his inspection tours, and after a day or two he stops the game and dismisses his entourage to their homes to wait until called out again by the sound of the trumpet. This makes it necessary for the section men, shopmen and other employees to do it all over again. If the gentleman could hear the comments of the employees and petty officials after the inspection he might think that surface indications were sometimes misleading. As stated before, the gentleman is one of the cleverest men in the railroad world. He is original in many

respects, and he has inaugurated a great many improvements in matters of transportation, but in keeping up this annual inspection he is simply following the custom of a by-gone age.

The writer will give a few personal reminiscences to show the stage plays and absurdities which surround inspections (the statements could be supported by affidavits if necessary). A roadmaster was notified that the general manager was planning to inspect his division in the near future. There was a lay-over station for freight crews on the division. There were two section gangs located at this station. The roadmaster advised both foremen to clean up the station grounds and put everything in as neat a condition as possible before the arrival of the general manager. The general manager arrived, inspected the station and wired the resident engineer that it was in a disorderly condition. The resident engineer referred the report to the roadmaster, who was very much surprised, as he had inspected the station just before the arrival of the general manager. He went to the station and interviewed the foremen and the agent in regard to the inspection. They informed him that the general manager had made a very critical inspection, but nobody had heard him make any comments. The roadmaster invited the agent to walk around the yard with him to see if they could discover the cause of the report. They failed to find anything out of order except a few timbers near a car repairer's shop, which was under the jurisdiction of the car repairers. The roadmaster reported the result of his investigations to the resident engineer.

Several months after the roadmaster was again notified that the general manager was about to start out inspecting. He immediately started in to put everything in such a shape that there could be no chance for unfavorable criticism. Before the arrival of the general manager the assistant resident engineer called on him and asked him if the "lay-over-station" had been thoroughly cleaned up. Upon being answered in the affirmative he suggested that they both go there just to see that everything was O. K. for the general manager. They found the station grounds faultless, but the assistant resident engineer ordered the roadmaster to hire a team and put both section gangs and the team at work for one day cleaning up the streets adjacent to the station. Of course the roadmaster did as he was ordered to do.

The prosecution of the work caused many jocular remarks from the residents about the railroad company having usurped the duties of the streets and alleys department. That general manager has passed into that unknown country from whose bourne no traveler returns.

If the general manager could come along in an aeroplane and look down what a sight would meet his gaze. Section gangs "galvanizing" and cleaning up; shopmen and roundhouse employees cleaning windows and up on top washing off the roof of the roundhouse and other buildings.

A roadmaster notified his foremen that the annual inspection was expected to begin on a certain date, and that they must drop everything and prepare for the inspection. Similar orders were issued to all other employees.

At the end of the month the roadmaster went over the division and asked the foremen if the sections were in proper shape for inspection. Of course the answer was in the affirmative. He then informed them that the inspection had been postponed but that it might be expected to begin any day and that they were to keep on cleaning up and shaping up (galvanizing) until the great event came off. Some of your readers may think that I am exaggerating, but it is the honest truth that the inspection did not come off for nine months, and during every month of that time the roadmaster kept on repeating the foregoing injunction to his foremen.

Money had been spent lavishly on this division during the two preceding years, otherwise it could not have held up under such strenuous galvanizing and cleaning up.

A section foreman was renewing ties and making general repairs on a piece of track. The assistant roadmaster came

along and ordered him to drop everything and start cleaning up for inspection. After several days he found that a certain piece of track had got so rough that it was necessary to give it immediate attention, so he determined to get in a day's work on it at all hazards. As luck would have it the superintendent and petty officials came out on a preliminary inspection whilst he was doing the work. They did not stop to ask the reason why, but when the next train came along the engineer threw off a letter to the foreman; it contained a very emphatic demand for the reason he was guilty of such gross disobedience of orders. The foreman made the very lame excuse that the track was so awfully bad that it had to be attended to.

A foreman was so unfortunate as to have his section newly ballasted just before the road had adopted standards for doing such work. Neither the foreman nor the roadmaster knew how the ballast should be shaped or how the "toe line" should be laid so as to conform to standards that it was known were being prepared at the general office. The work had to be done, so they decided to work according to a standard that was in common use on other roads. They stretched a line along the roadbed and laid the "toe line" to it on top of the ground. When the standard forms were issued it was found that the cross section of the ballast was too wide; it did not have the proper shape, the "toe line" rock should have been sunk in the ground, showing two inches above ground and have a true surface and running line.

After the discovery was made it was impossible to remedy the error without going to too much expense. The foreman of that section never wore the general manager's medal nor did he have his tool house adorned with the magic sign which would proclaim to the world that his was the best section on the system or on the division.

By the way, on this road each foreman was supplied with two rattan brooms with orders to detail two men every morning to go over the section and sweep the dust off the "toe line." But the most absurd thing was that the roadmaster gave the foremen orders to conceal part of their gangs whilst the inspection train was passing over their section—not to have more than four laborers in sight. As the gangs were mostly foreigners they could not understand why the foreman should put them out of sight while the inspection train was passing.

A vainglorious foreman was awarded the prize for having the best section. He was highly elated and determined that he would capture the prize next year. He failed to get the award, was awfully crestfallen, said it was a plain case of partiality and quit. Some time afterward the writer was discussing the matter with the superintendent, who informed him that two sections were in such fine condition that it was a very difficult matter to decide which was best, but they decided that the other foreman's section was just a "leetle bit better."

There are some things beneath the surface that the general manager's "eyes and ears" do not keep him informed of. Suppose that the management of a railway system desired to do away with annual inspections, could a system be devised that would answer the purpose just as well and prevent the roads from going to the "bow wows?" Possibly such a thing could be done. To begin with, we must assume that the superintendents of divisions, resident engineers, roadmasters, trainmasters, master car repairers, master mechanics and general foremen of bridges and buildings are all competent, energetic and loyal to the company. Certainly these men receive a fair remuneration for their services, and if the company does not have the right kind of men in these positions somebody is to blame. That being the case, each one should be held to strict account for the work assigned to him. Each of these men could furnish semi-annual reports showing in detail the actual physical condition of the property. These reports could be accompanied by lists of improvements which were deemed necessary, together with probable cost as estimated by them, also suggestions in regard to changes which might be made for the good of the

service. One copy of each man's report should go direct to the general manager, without revision or change.

The writer is cognizant of a case where a passenger train was derailed (without serious injury to persons) because a petty officer of the company persisted in turning down the roadmaster's requisitions, because of a personal antipathy. The roadmaster could not make a fight, because the odds against him were too heavy. Three section foremen lost their positions on account of this derailment, although a proper investigation would have demonstrated their innocence and shown who was really responsible for the wreck.

Either or both of two methods might be adopted by the general manager to satisfy himself in regard to the accuracy of the semi-annual reports, and also to know what was going on at any point on the lines that he might desire to investigate. He could make a flying trip himself (without notifying the trumpet major) and make a personal investigation. Or he could avail himself of the services of a reliable man, one whose past experience and training was such as to enable him to make fair and accurate reports regarding the general physical condition of a railroad, its buildings, structures, etc. His identity should be kept secret, for although he should not be confounded with the genus "spotter," his work would be of such a nature that he should be free from intimidation, importunity and hoodwinking. The general manager could dispatch him to various points along the lines to verify his subordinates reports, or note inaccuracies which had crept into them. When out on the road he would note any slackness on the part of employes or defects in the service which might be remedied. He would often be able to ascertain if selections for appointments, changes and promotions in the service were free from nepotism and partiality, and were made solely for the good of the service. A short time after this man had been on a division the superintendent would receive a letter from the general manager notifying him that a fence at a certain point was in bad order, that material at a certain point was not properly piled, that track at a certain point was very rough, that the agent at a certain station was very surly, that switch targets needed painting, that right-of-way at a certain point was not receiving proper attention.

Sometimes the letter might call the superintendent's attention to matters of greater importance, also to deviations from the standards adopted by the system. Sometimes the inspector might visit a division and find everything O. K. except perhaps some non-essentials which he might report to the general manager, who would use his discretion in the matter. He should note, particularly, trespassing or encroachment on the company's property. The inspector should be impressed with the absolute necessity of accuracy in making his reports, so that if a report was challenged, its correctness could be proved beyond all doubt. He should be given to understand that as soon as his identity became known his services would be dispensed with. This system would keep the property in a normal condition at all times, and do away with washing the roofs of buildings, dusting "toe lines" and concealing laborers in the brush. "A sham is still a sham if called by any other name."

(Signed) R. Pottol,
Colfax, Calif.

WOODEN OR IRON CROSS TIES.*

By Mr. Rectanus.

The Baden State railways first experimented with iron cross ties in 1881; two designs were tried out and the Hif pattern given the preference. At the close of 1911, 96.2 per cent of the cross ties in use on this railway were iron. Critics have charged that this construction is uneconomical, and the facts stated herein are taken from a report of the management of the road to the government, answering these criticisms.

The mean life of the iron cross ties as designed in 1881 with a height of 2½ ins., is 30 years; the mean life of the 1891 and 1894 designs, 2½ and 3½ in. high respectively, is 35 years.

These actual figures were obtained from the total number of cross ties purchased and the total number which were taken out on account of unsatisfactory conditions.

The wooden cross tie track, used as a comparison, was of two types, one with hooked and sole plates, the other with pads of poplar wood between tie and rail. The latter had three screw spike fastenings, one inside and two outside, alternately, to prevent creeping.

The life of wooden cross ties, determined from the records of the Saxon State Ry., showed (in 1881) a life of 15 years for cyanized wooden ties. Pickled pine ties have an average life of 20 years. Full cell treated beach ties have an average life of more than 25 years, with medium traffic (from accurate data of the French Eastern Ry.).

The tables† of comparison of costs of wooden and iron cross ties for 1899, given herein, show comparisons only between the cost of the iron ties and what is considered a good average price of wooden ties.

Comparison of Iron Cross Ties with an Average Life of 35 Years and Beech Ties with an Average Life of 25 Years
(Per Mile of Track, 1911 and 1912 Contracts).

	Iron sleepers	*Beech at \$1.35, with base and hooked plates	†Beech at \$1.63, with wood shims and screw spikes
Construction cost.....	\$5,157.00	\$4,518.00	\$4,534.00
Value of scrap.....	2,100.00	791.00	481.00
Net cost, construction..	\$3,057.00	\$3,727.00	\$4,053.00
Amortization, per year..	46.00	92.90	102.00
Interest on const. cost..	136.00	154.00	157.00
Total	\$232.00	\$ 256.00	\$ 259.00

17 iron or wooden cross ties to 39 ft. 4 in. of track. Interest at 3½ per cent.

From the seventies up to about 8 years ago, Baden State Ry. carried out its maintenance by foremen under contract, so that it is easy to obtain an exact comparison of the cost of maintenance of track on the iron and wooden sleepers. From 1876 to 1894, the following changes took place in wages and unit prices of work.

	Rate of wages.	Main. cost per meter.	Unit price for renewal.		
			Intermediate tie.	Joint tie.	Rail.
Increase, per cent... 36		31	5	0	20
Decrease, per cent...	15**	..

For increased amount of ballast necessary with iron cross ties, the cost is \$27.35 per mile, which reduces but does not overcome the advantage of the iron cross tie.

Taking everything into consideration, iron cross ties are more economical than pine ties, when the latter cost more than \$1.10 (life 20 years), or than beech ties, which cost more than \$1.32.—*Bulletin International Ry. Congress.*

*Baden State Ry.

**Suspended joints were substituted, eliminating supported joint tie.

†Editor's Note.—These tables were much more extensive, and were designed to show how cheap the wooden ties must be, in order to give a lower ultimate cost than iron. Tables of comparison were also given for the years 1881, 1893 and 1894.

These tables indicate that the iron cross tie is cheaper.

††French Eastern Ry.

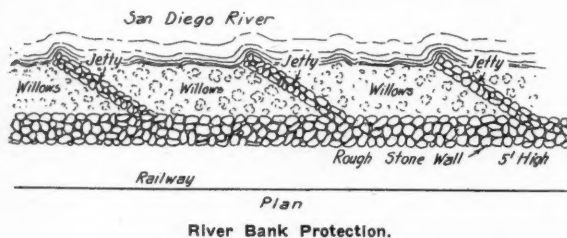
DRAINAGE AND DITCHING.

T. F. Stewart, Roadmaster.

Surface Ditching.

The provision for carrying off the surface drainage of the land traversed by the railway comes more properly under the head of construction or engineering work than of maintenance or track work. The necessity of providing ample waterways at all bridges and culverts is universally recognized, but it is not always observed in practice. In maintenance work, therefore, the engineer, roadmaster and section foreman should have in mind what culverts or waterways are occasionally of insufficient capacity. Until increased capacity can be obtained care must be taken that the opening is kept free from dirt, drift and obstructions, that no fencing is placed across it, and that the sides of the stream or the slopes of the embankment are protected from wash. This protection may consist of rip-rap of rough quarry stones, brush, willows bound in sheaves and anchored, willows planted and grown along the foot of fills where liable to wash, cribbing of trees and logs, or trees laid on the slope with the trunks pointing up stream and the branches weighted down in the water.

No fences or wires should be allowed across drainage openings, as these check and collect drift which may block the waterway and cause washouts in time of flood. The foreman should mark flood high-water levels for the future use of the



engineer in investigating the necessary capacity of openings. Every opening in the roadbed is to a certain extent a source of danger, and the old style of open culvert is giving way to culverts of concrete, iron pipe, stone, etc., covered by the embankment.

I have a half mile of track lying along the river where, in time of flood, current strikes very hard. This I have rip rapped with large quarry stone to the same height as the fill; in addition to this I built jetties of the same height as the main wall a sufficient distance to turn the current away. Fortunately two dry years followed, and we got a good growth of willows started between the jetties, as shown on the following drawing. The oldest of these willows are now six years old and quite large. Eight years ago we had a washout that cost over \$3,000 to repair. The new fill was built of adobe and surfaced on 12 ins. of decomposed granite.

I have also used with considerable success a breakwater made as follows: Use old switch ties, 10 and 12 ft. lengths, set five or six ft. deep in foot of fill, eight ft. apart, and stretch No. 9 smooth wire 12 ins. apart and nail securely. Build wings or jetties at an angle of 30 or 35 degrees, of the same material. This inexpensive precaution will turn a considerable current. The value of sand sacks is generally known, as is also the value of walls made of 2x12 in. boards and banked and supported from behind by earth, or even timber braces reaching across to foot of fill.

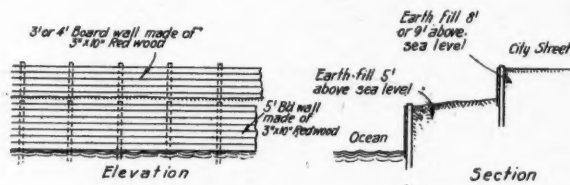
The time to fight washouts is before they occur. Surface ditches at the top of cuts save much annoyance. I have three miles of sandy track which washes badly from surface water from the hills. This section has been planted with Bermuda grass, which affords considerable protection in this climate. This grass grows all year, the roots reaching to a depth of two and three ft. and forming a compact mass. As the grass does not grow to a great height it does not interfere with traffic, and furthermore it keeps down dust in dry season. The

accompanying sketch is of a rough stone wall along our eastern main line. This wall and jetties are built of rough granite boulders laid on thick brush mattress.

Coronado City, across the bay from San Diego, Cal., is protected by a rough stone sea wall, which, however, rests on the sandy ocean beach and requires more or less attention. The city and state have just completed repairs which required over 3,000 carloads of large quarry stone. Over one mile of Coronado beach is protected by a timber wall made of 3x10 in. and 3x12 in. plank, supported by earth filling, as described above. At this point the tide does not strike so heavy and the breakers do not do so much damage as further north.

Underground Water.

The drainage of ground water from the land is a different problem, which may be very serious in wet soil and on side hill lines. The methods adopted will depend upon the character of the soil, the geological conditions and the amount of water to be dealt with. In bad cases, special treatment may be necessary to prevent slides. These cases may be where the cuts are in wet clay or where the upper body rests on a smooth and sloping stratum of rock or hard clay, which not only holds water in the upper body, but provides a surface upon which the mass may slide if disturbed. In Europe these conditions are often investigated very fully before and during construc-



Ocean Wave Protection.

tion, and costly works are provided to establish permanent conditions. In this country reliance is apt to be put on more superficial investigation and the adoption of temporary expedients, with consequent high cost and continual trouble in maintenance. The question in each case is how best to remove the water and solidify the treacherous material.

Soft spots sometimes appear continually in cuts or banks, requiring periodical filling and surfacing and the cleaning out of ditches. Such cases should be carefully investigated, as the filling is evidently only a temporary relief and makes conditions worse. The first thing is to find where the water comes from, and remove or provide for its escape. The soft material may then be dug out. Cinders are generally best for filling, as they will not mix with the clay, like stone or slag.

Where a firm material underlies the sliding material, trenches for tile drains may be cut into and through the former, and then filled with cinders or gravel. It is not much use to put a tile drain in the wet or sliding material, as the movement of the mass will distort it, throwing it out of line and filling up the drain. If a cut slides in winter or in bad weather, ditching it out will often keep it sliding or make it worse. In such cases, as long as the material does not encroach on the track it may be best to leave it and cut cross drains through the ballast to carry the water to the ditch on the other side of the track.

Side Hill and Cut Drainage.

On side hill work ample provision must be made for carrying off the surface water by culverts, ditches and drains. A surface ditch near the top of the cut will intercept much water that would otherwise flow down the slope. There should be a good ditch at the foot of the slope of cut, and under this may be a tile drain with laterals extending under the roadbed and discharging on the down hill side. Drainage is of special importance in grade reduction work, and care should be taken to see that deepened cuts are well drained. Tile drains may

be used to advantage when such work is done to supplement the ditches.

The width of sub-grade should be increased in wet cuts, to give ample room for ditches. It will also allow of putting the ditches further from the roadbed, which is necessary to prevent water from seeping into and saturating the latter. In practice the cuts are often made too narrow to allow of proper ditches, and expense is incurred in subsequent widening or in constant maintenance and in cleaning ditches. The slopes, also, are often left too steep, increasing the liability of slides or causing a constant falling of surface material into the ditches. If the proper width for slopes and ordinary ditches cannot be obtained, as in cuts through valuable property, masonry retaining walls may be built near the track, and the slopes commenced from the tops of these walls. Ordinary or sheet piling is sometimes necessary in the slopes or at the toes of cuts. In soft cuts deeply gullied by rain, cribs of old ties are sometimes used, but are unsightly and generally of only temporary value. Such cribbing should be higher at the track side sloping back to the bank, so as to afford greater resistance to displacement, while the edge forms a convenient platform from which to shovel the sliding clay into cars.

It has been found in cuts through clay with an overlying stratum of earth, that if the material is excavated to a vertical face at about the middle of where the ordinary slope would be, when the face sloughs off the earth will cover the clay and protect it from the weather. Some wet cuts on the Canadian Pacific Ry. had to be cleaned out and widened with a steam shovel, and then two rows of piles, eight ft. apart, were driven on each side of the track; sills laid under the roadbed kept the inner rows from moving, and inclined braces were put between the inner and outer rows. The mud was dug out and coarse gravel filled around and behind the piling, through which gravel the water drained to the track ditches.

At the Boone viaduct of the Chicago & Northwestern Ry., a sliding hillside was checked by digging trenches 250 ft. to 350 ft. long. These extended in the direction of the movement, and varied from four ft. in depth at the lower end to 10 ft. at the upper. They were five ft. wide on the bottom, and were filled with three ft. of one man rip-rap and two ft. of willow brush, covered with back filling. A track along the side hill slope and subject to continual slides was made secure by means of surface drains. Wooden box chains were put between the ties at intervals of 10 or 15 ft., and extended to the slope of the hillside, with occasional diagonal lateral drains leading into them. The best remedy in cases of this kind is to thoroughly investigate the conditions and to provide ample drainage, with ditches of sufficient capacity to carry off the water quickly, and then to provide such auxiliary work as may be necessary.

On the Chicago division of the Cleveland, Cincinnati, Chicago & St. Louis Ry., trouble has been experienced with the slipping of a wet side hill cut about 40 ft. deep. The material is a wet yellow clay (standing at about one or one and one-half) on a stratum of shale or hardpan. Water soaking through the clay mass gives a smooth and slippery or lubricated surface to the shale, and upon this the clay slides. The movement was evident nearly one-quarter mile from the cut. Near the cut was a public highway, and this was only kept passable by filling in from the top as the earth slipped towards the cut. The road was about 75 ft. out of line. Two rows of piles were driven along the lower side of the original line of the road, and two rows of piles were also driven at the toe of the slope. The rows were four ft. apart, with piles also four ft. apart, the rows being staggered. The piles penetrated about six ft. into the shale. A layer of brush was filled between the two upper rows of piles, and this was covered to a level about two ft. below that of the road. The road was then back-filled to the original line and covered with broken stone. No brush filling or other work was done at the lower row of piles. Two trenches about three ft. wide were then cut in the slope, being excavated into

the shale and filled with about four ft. of loose rock. These works were very expensive, but accomplished their purpose in stopping the slides. The track ditch at the foot of the slope was made of large capacity, and along it a rip-rap wall two ft. high was built just outside the ends of the ties, to prevent washing of the roadbed by the water in the ditch. Three cross drains of 18-in. cast iron pipe extended under the roadbed from this ditch, discharging on the downhill side. There was also a line of eight-in. drain tile laid between the tracks.

A constant trouble in cuts of wet loose material is the gully-ing or washing of the slopes by rain or drainage water. This may be checked, especially in side hill cuts, by cutting a surface ditch at some distance from the top, so as to intercept the surface drainage. The ditch should be at least three ft. from the cut, with the earth thrown on the side next the cut. It may be about 18 to 24 ins. deep, 12 ins. wide at the bottom, the size varying with the amount of water to be dealt with. The ends should be curved out, or led to a culvert or to the ditch at the toe of the adjacent bank, so that the water will not wash the face of the bank. If the earth is very soft or porous, the ditch may be lined with plank or concrete. Another method is to have drains cut diagonally along the slope and filled with bundles of brush or saplings, broken stone, or semi-circular tile, to intercept water draining through the soil.

Trenches about two ft. wide and two ft. to three ft. deep are cut straight up the slope and filled with broken stone. The distance between these trenches depends upon the amount of water and the character of the material. They may be connected by diagonal or lateral drains. Where springs break through the slope, drain pipes may be inserted and a gutter or an apron of stone rip-rapping laid from the outlet down to the track ditch. To prevent the breaking down of the corners of cuts and banks these may be rounded. Mr. J. D. Whitmore, consulting engineer of the Chicago, Milwaukee & St. Paul Ry., has advocated this course, together with the paving of ditches and the sodding of slopes. The curves would be about six ft. radius for edge of bank, 10 ft. for toe of bank, 15 ft. for top of cut, and two ft. for roadbed ditches. Proper drainage will generally put sliding under control and sodded slopes will check sliding and prevent surface washing. In Europe great care is taken with the dressing of slopes of cuts and banks to a proper face; they are then covered with good soil, and finished by sodding them or sowing grass seed.

Banks may be drained by ditches not less than three ft. from the toe of the slope, and material should never be taken from the intermediate berm for filling the bank or raising sags. The bottom of the ditch should slope slightly away from the bank. Borrow pits near banks should be drained. If there are springs underlying the bank, tile drains may be laid from the springs to the side ditches, or the earth may be dug out, broken stone and rock filled in, and rock-filled trenches made from the hole to the ditches. Special care should be taken with the drainage on side hill work to keep the bank itself and the ground upon which it rests well drained. In some cases benching and extra side filling or dwarf retaining walls are required to keep such a track in line.

Track-men should never be allowed to use the material from the top of the bank for ballast. The laying and cultivation of heavy soil will do much to consolidate and hold the bank. In banks of soft clay, wet spots and pockets may develop. The usual remedy is to dig out material near the top and fill in with stone, slag or cinders. If water still drains or seeps in, the conditions will not be permanently improved until the wet spots are drained, and any water intercepted that may be working along the bank. Piling may sometimes be necessary at the toe or in the slopes of banks of wet clay, to hold them from settling; on heavy fills that have been ballasted for years and where the ballast has worked down to a considerable depth in the top of the fill, thereby forming a deep trough that retains water which must soak through the side of the fill and into the roadbed, causing slipping, I would recommend the use of

drain tiling, but this will not be sufficient in very wet or unstable material. Improvement may be effected by spreading out to a slope or one to three, building up with good materials, putting in drains, as above, and laying good clean ballast.

Banks subject to the wash of waves, streams or floods should be protected by a rip-rap of rough quarry rocks or by trees or mattress work. Swampy ground requires special treatment of the roadbed. The Canadian Pacific Ry. has built some sawdust banks across swamps where gravel would break through the surface crust. The slopes are covered with earth to protect the material from fire. The Minneapolis, St. Paul & Sault Ste. Marie Ry. crosses a number of swamps in Wisconsin, many of which show soundings of 15 to 30 ft. Upon these is made a roadbed about two and one-half ft. high above ditches cut at a distance of 15 to 30 ft. from the slopes. The material is mostly peat, which, when dried out, makes a very light bank. The track was laid with three lines of small poles (three to four ins. in diameter) under each end of the ties, and only enough ballast was used to bring the track to a good surface. The track would creep under the heavy consolidated engines, and in some places ties 10 and 12 ft. long were used; angle bars were bolted to the middle of the rail and spiked to two ties. A 12-in. foundation of six-in. logs is sometimes built across swamps, being covered with bushes and ballast.

Sub-drainage.

Sub-drainage is frequently necessary (where the roadbed is in wet ground) and consists of stone, tile or pole drains, wooden box drains or trenches filled with brush. Good track is hard to maintain in wet places without sub-drainage, and there are many spots in cuts and under banks (especially in side hill work) where water seeps through and where nothing but sub-drainage will afford substantial relief. The tile drains are usually laid under the ditches on one or both sides of the track. On double track it may be under the middle of the roadbed, with laterals about 500 ft. apart. A depth of two and one-half to three ft. below the bottom of ditch is generally sufficient, but the drain should be below the frost line to protect the tile from heaving or breaking. The ends of the drains discharge into ditches leading to culverts or waterways. In wet cuts the tile may be laid in diagonal lines at a depth of about three ft. and six to 20 ft. apart, or to form lateral drains leading to the side drains, while the slopes may be drained by the tile in trenches and connected with the side drains. The common red clay drain tile without collars is generally used, but vitrified tile with open bell-and-spigot joints is used in some cases. The red or porous pipe is supposed to admit water through the sides as well as at the joints, but, on the other hand, it is believed that the clay soon becomes impervious, so that the smoother vitrified non-porous pipe open only at the joints will give equal capacity and better flow. Cement pipe is also being used. The drain should not be less than five-in. diameter, and of ample size to carry off all the water freely, as there is little difference in the cost of laying. Porous drain tile is usually in 12-in. lengths, while the vitrified pipe is in 18-in. lengths. Great care should be taken to lay the drain properly, getting tight joints and uniform grade with all the fall the outlet will allow. The grade should not be less than three ins. to 100 ft. Tile should be covered with marsh grass if possible, although hay or straw are better than nothing. The joints should be covered with strips of sod or turf, and the trench then filled with cinders, gravel or other porous material. Stiff clay may be used, but sand or loam laid directly upon the drain will work its way into the pipe. The trench above, however, may be filled with such material. In laying in quicksand or mud it may be necessary to use a plank bottom or trough covering as fast as laid to prevent displacement.

Where sub-drainage is required in wet cuts on the New York Central Ry. the trenches are three and one-half ft. deep, with six-in. or eight-in. drain tile laid in a V-shaped trough of hemlock planks one by six ins., butt-jointed. The tiles are laid

open joints and covered with strips of sod; over this is a layer of gravel, and the trench is filled with broken stone, which is spread over the surface of the roadbed ditch to prevent washing by the cross drains laid between the ties. Extensive work may be done by an extra gang equipped with the special tools used for ditching and tile laying. Where the drain is laid on one side of track only, it should be laid on the higher or upper side to intercept water that might flow under the roadbed. Where a spring underlies the roadbed in a cut, tile cross drains may be laid at intervals, sloping slightly towards the sides and connected at each end with the tile drains under the ditches. The outlets of all drains should be looked after and kept free, especially in winter, as springs may keep water running in cold weather. Loose stone or a cap of wire netting should be laid at the ends to keep out small animals. Both ends of the drain should be kept open and free to allow circulation of air through the drain. The cost of laying tile will vary from 25 cents to 60 cents per rod, according to material; it may be even more in quicksand cuts. In general the drains, if of any extent, are laid by men experienced in this particular work, and not by the ordinary section gangs, as the former can usually do the work quicker and cheaper. In laying, the tiles or pipes may be kept in line by stringing them upon a pole about the diameter of the pipe. This is left in place until a length of back filling is done, when it is pulled ahead for another set of pipe, its heel remaining in the pipe already laid as a guide.

Drainage of the roadbed is a most important factor in the keeping of good track. In localities and districts with much rainfall it is most important to keep the ditches clear of grass, weeds, and a liberal allowance of labor should be provided and times given each year for overhauling ditches, waterways, breakwaters, etc. The outlay of a moderate amount of money may avoid an expensive washout and demoralization of traffic. In doing this work attention should be given to uniform grades, direct lines, ample waterway, even bottoms, etc. Ragged edges and obstruction of rock and roots should be removed to permit a free flow and avoid catching drift, etc., which may choke the ditches. The growth of grasses may be encouraged on slopes, and this practice seems to be increasing.

ROADMASTERS' ASSOCIATION 1914 COMMITTEES.

1 *New and improved track, tools, manual and power driven.* J. W. Dahl, chairman, N. Y. C. & H. R.; Coleman King, L. I. R. R.; H. E. Astley, N. Y., N. H. & H. R. R.; P. H. Madden, C. & M. & St. P.; D. O'Hern, E. J. & E. Ry.; C. J. Coon, N. Y. C. & H. R. R. R.; G. H. Brooks, St. L. T. Ry.; J. J. Duffy, C. & I. W. Ry.; D. Foley, M. C. R. R.

2 *Proper organization and economical use of labor and material for safe maintenance of track.* P. J. McAndrews, chairman, C. & N. W. Ry.; William Shea, C. & M. & St. P. Ry.; Emmett Keough, C. & B. & Q. Ry.; J. O'Connor, M., St. P. & S. S. M. Ry.; W. E. Haberlaw, C. & R. I. & P. Ry.; M. Griffin, C. R. R. of N. J.; T. Hickey, M. C. R. R.; W. E. Davin, P. & L. E. Ry.; A. E. Hansen, A., T. & S. F. Ry.

3 *Proper method of rail renewals.* A. M. Clough, chairman, N. Y. C. & H. R. R. R.; W. J. Edwards, A. G. S. Ry.; C. H. Gruver, C. & R. I. & P. Ry.; J. H. Reagan, G. T. System; John Shea, D. & I. R. Ry.; J. E. McNeal, A., T. & S. F. Ry.; M. J. Connerton, C., N. O. & T. P. Ry.

4 *Proper type of track accessories.* M. Donahoe, chairman, C. & A. R. R.; G. Beckingham, G. T. System; J. A. Roland, C. & N. W. Ry.; I. C. Ellison, S. L. I. M. & S. Ry.; J. B. Mabille, C. & R. I. & P. Ry.; J. H. Cummings, B. R. & P. Ry.; A. M. Anderson, C., M. & St. P. Ry.; T. Mahoney, B. & O. R. R.

5 *Cleaning and policing the right of way from the standpoint of safety and economy.* J. P. Corcoran, chairman, C. & A. Ry.; Edward Leason, C. G. W. Ry.; M. Murphy; Joshua Buel, A. C.

R. R.; S. L. Purdy, A., T. & S. F. Ry.; A. A. Wells, Southern Ry.; H. T. Reinicker, N. & W. Ry.

6. *Arrangements committee.* M. Burke, chairman, C., M. & St. P. Ry.; Thomas Thompson, A., T. & S. F. Ry.; James Sweeney, C. & E. I. Ry.; William Shea, C., M. & St. P. Ry.

EFFECT OF EXTRA GANGS ON SECTION FOREMAN'S ABILITY.

It is most obvious that in the discussion of this subject that one must give due consideration to the fact that extra, or floating gangs as they are sometimes called, may be used to a better advantage on a three or more track system; the assumption naturally being that a road that can support a third track system necessarily has sufficient traffic to warrant such trackage, and it therefore follows that to such a road the delays occasioned and the inconvenience experienced is of no little consequence to the management. And it is true that many delays are chargeable to track department for the reason that when they obtain permission from the dispatcher to use a certain piece of track, for renewal purposes, and have not sufficient force to do the work promptly and get track back into service.

To my mind, on a road where the track forces are not affected by depression of business, and the men are not laid off on account of the approach of the winter months when track work is to a certain extent curtailed, the section gangs should be large enough to handle all matters of maintenance required on their respective sections. This not only to include renewal of ties, cleaning of ditches, mowing banks, resurfacing, etc., but the more important work of re-ballasting and rail renewals, also general renewals of frogs and switches in connection with repairs to interlockings. Of course if this is done it is at all times necessary to have a section gang of 12 or 14 men, which size gang is not any too large on any section where 100-lb. or even 85-lb. material is used. However, if it is the custom on a particular railroad to reduce the section force to six or eight men during the winter months, the advent of spring brings so much work with it that the regular section forces are obliged to spend a greater part of their time on detail work, such as construction and cleaning of ditches, line and surface that has been neglected during the winter months on account of insufficient labor, that it is frequently necessary to procure extra gangs to take care of large renewals while the regular foreman devotes his time to items of miscellaneous work that perhaps could have been kept up to date had he been allowed sufficient force to do so.

It is very doubtful whether much good is accomplished by combining section forces for renewal work. In the first place if the section foreman is allowed a gang of 12 or 14 men it will be unnecessary to combine gangs, as the regular gang is sufficiently large to handle the work alone. When two or more gangs are combined the men take orders from two or more foremen which very often results in confusion to the men; especially is this true of the foreign laborers, who are accustomed to working with and receiving their instructions from one foreman. Again when two foremen are in charge of a piece of work the responsibility is more or less divided and very often when an accident occurs, under such conditions, the men advise that they were under the impression that the other foreman would look after certain matters of importance, and for the reason that the responsibility was divided the matter was overlooked. Of course, this is purely a matter of supervision, and when an extra gang is sent to a certain section to assist with work the understanding should be perfectly clear that the regular section foreman is responsible and that the work is to be done under his supervision.

Generally speaking, extra gangs employed for extra work of a specific nature, are not as efficient as regular gangs, due to the fact that they realize that their work will last for only a short time and that by the time the work has been given a

fair test, and the poor workmanship has been brought to light the gang is likely working at some other point or where it will not receive the criticism it richly deserves.

The matter of the efficiency of the work done by extra gangs depends entirely upon the fidelity of the foreman in charge, and if he is a man who is interested in the supervisor's or roadmaster's division, regardless of the section on which he may be working, he will insist upon the work being done in such a manner as will bring credit to his superior.

It is generally the practice on a supervisor's division, having between 15 and 20 section gangs, to have two and sometimes three floating gangs, and these gangs are assigned to various items of work, such as relaying rail, reballasting, renewal of ties, rendering assistance to the master carpenter's department in repairs to buildings, bridges, etc., and such gangs usually take the same interest and do their work in just as efficient manner as the regular section gang; and with such a gang we can feel that the renewals they make are just as well done as if the work had been performed under the directions of the foreman having supervision over that particular section.

It would appear that to have an extra or floating gang as above described, would in a measure be unfair to the section foreman, as with such a gang the supervisor would naturally assign it—the floating gang—to such work as renewal of frogs and switches as well as the installation of new switch work, and if this practice is carried out regularly the section foreman will soon depend on the floating gang for such work, while he himself will become "rusty" in the matter of switch work. This may seriously interfere with his advancement or promotion in the service, as it is quite true that what all our great railroads want today is foremen who are entirely conversant with all matters in connection with switch installation and renewals.

More difficulty is experienced in obtaining laborers for extra gangs for the reason that they are more or less unsettled and are liable at any time to be moved to another part of the division, making it almost impossible for the men to have any quarters that will in any way resemble a home or even a well-kept camp, and it is true that even the foreigner now likes to be permanently located where he can spend time in the evenings in the cultivation of a garden and in many cases the beautifying of his home. Even in cases where it is possible to have the gang stationed at one particular point and allow the men to travel to and from their work on passenger trains, we hear numerous complaints, as the men are obliged to get to station in advance of arriving time of trains in order to get their tools collected, and they are usually late in getting back to headquarters, and when they do finally reach their shanty or camp they are obliged to build fires and do their own cooking, making it very late when they get their evening meal.

There can be no doubt as to the foremen on section gang being able to do his own reballasting, and if we give him sufficient force there is no question but what he will do it and it will be well done. All our foremen are able and capable of handling gangs sufficiently large to do the work on their own sections. In fact I do not consider it possible to give a section foreman so many men that the supervision will be a burden to him, and I am well satisfied that at least 90 per cent of the foremen would be willing to handle at least 20 men and do all their own work rather than depend on the assistance afforded them by the extra gangs.

We believe that extra foreman, or rather foremen for extra gangs, may best be obtained from the regular section gangs. The supervisor on his numerous patrols of the sections will not be slow to discover the men in the gang who show adaptiveness for the position of foreman, and when the organization of an extra gang is necessary he can quickly lay his hands on a man who can handle same, and the advantage of this is that the man is "one of his own boys," and he can feel satisfied that he will take a keen interest in the work and endeavor "to make good."

MAINTENANCE WORK BY SECTION FORCES COMPARED WITH SUCH WORK WHEN AIDED BY EXTRA GANGS.

By J. W. Powers, supervisor of track.

It is a fact generally conceded by railroad men, although probably not thoroughly appreciated by the traveling public, that the maintenance of way department of a railroad is one of, if not the most, important of the many different departments which characterize the railroads of today. To earn this enviable reputation and meet the exacting conditions and demands of this branch of service it has been necessary for the maintenance of way department to keep their track up to a high standard of efficiency to meet the existing conditions, namely, the increase in speed of trains, in capacity of cars and in weight of engines, all of which necessitates the proper organization of track forces.

There are various opinions expressed regarding the most efficient methods of repairing and maintaining track. Most trackmen agree that ordinary repairs can be done by section gangs which usually consist of three or four men in the winter and are increased to six or eight in the summer, the increase depending on the nature and condition of work to be done and the amount of traffic.

It is customary on many roads when heavy tie renewals, ballasting, laying new rail, building side tracks, etc., are in progress to employ extra gangs to aid the section gangs to do this work. However, some trackmen maintain that it is better to increase section forces or combine several gangs than to employ extra gangs.

Personally I am not in favor of increasing section gangs or combining them to handle all regular maintenance work, ballasting, relaying rail, tie spacing, etc., for the following reasons:

There are some foremen who give excellent results with six or eight men, but are incapable of handling larger forces. There are others who are competent of doing ordinary track work, such as surfacing, gauging, lining, putting in ties, etc., but are incapable of doing ballasting, renewing rail and complicated switch work.

The foreman is the one who can and should advance the efficiency and labor of the men, and is the one at fault if the work is not satisfactory, whether on extra or section gangs. A good foreman can produce good work with a poor gang, while an incompetent foreman cannot produce satisfactory work with an excellent gang. The former is cheap at any reasonable price, while the latter is so expensive that no railroad company should give him employment. Our extra gang foremen are promoted from the ranks of the section foremen. Preference is given to the one who is capable of exercising good judgment and devising time and labor-saving methods, and who has had actual experience in switch work, ballasting, rail renewing, etc.

From experience I have learned that it is less difficult, in certain localities, to obtain and keep men in extra gangs than it is to increase the section forces. As a rule no more difficulty is experienced in handling extra gangs than section forces, provided that each man is performing work for which he is adapted.

In some instances the increased section forces are more efficient than the extra gang, due to the fact that from 25 to 50 per cent are composed of experienced men who will help educate the others, who will in a short time become fairly proficient. This, however, applies only to roads where the extra gang is employed for the summer season. On the majority of our trunk lines, some of the extra gangs have steady employment, and under the supervision of a competent foreman become more efficient to perform certain kinds of labor than section forces.

One of the objections advanced by some who are opposed to extra gangs is that the work performed by them is of an inferior quality to that done by section forces, and that it is necessary for section men to follow up the extra gang in order to get the track in first-class condition.

The quality and quantity of work performed by an extra

gang will depend to a great extent upon the ability of the foreman and the excellence of the supervision given by the roadmaster or supervisor, who should insist upon and accept nothing but first-class work. The work performed by the majority of extra gangs, under proper supervision, is as satisfactory and holds up as well as that performed by regular section forces.

There are advantages and disadvantages in both methods, that of increasing or combining section forces or in employing extra gangs. It is much harder to find a foreman who is capable of handling several section gangs than it is to secure one who is competent of handling an extra gang, because with the former the foremen and their men will not co-operate with him unless he is a general favorite. Therefore it becomes necessary for the supervisor or his assistant or general foreman to take charge of this work to obtain the desired results.

One very important fact which is sometimes overlooked in combining section forces, is the amount of time lost in going and returning from the work, especially where the train service is not the best, besides the constantly increasing defects in track which are soon noticeable where section forces have been taken away and are absent, even for a short period of time. It costs more to put the track back in its normal condition than it would to employ an extra gang to do the work for which the section forces were combined.

It is a common occurrence to find the increased or combined section forces working with a smaller number of men than is usually allowed an extra gang, which is a great disadvantage when doing certain work. With a small gang it is necessary to change work and tools several times a day, which is not the case where a large force is employed, as the men can be so organized that each man will continue at the same task the entire day, if necessary, which saves much time and confusion.

To illustrate this fact, we will consider a rail-laying gang. Five men could be placed pulling spike, three men throwing out the old rail, two men putting in tie plugs, six men leveling and adzing ties, fourteen men laying in new rail, one man holding new rail in place, one man putting in expansion shims, six men putting on angle bars and six men spiking. In this manner each man has a certain duty to perform and there are no unnecessary delays or confusion, which is not the case where a small gang is employed, for it is then necessary to have the men who are placing rail in track assist in bolting and spiking, and the result is a great deal of time is lost in changing from one class of work to another.

Experience teaches that it requires from 10 to 20 minutes, when laying rail, to close in and get track in condition to allow trains to pass. If only 20 or 25 men are employed to do this work, they would have to make twice as many connections in laying a certain amount of track as a gang of 40 or 50 men. This greatly increases labor, and delays to trains. Consequently a well-organized large extra gang is more efficient than a small gang, as the former does the work simultaneously and in a systematic manner.

System, beyond all doubt, is one of the most important factors in the successful execution of work of any kind. Without it the amount of energy applied is out of all proportion to the value of the results achieved. With it the ratio of those two quantities approximates to unity and efficiency approaches a maximum. Lack of a systematic method of procedure and the absence of any well-preconceived plan will soon make itself evident, especially where large forces are employed.

CINCH FENCE STAYS.

Economical and efficient fence construction and repairing enter into one of the most important problems confronting the engineering and maintenance departments of railroading. An ingenious device which lessens the cost of fencing is the "Cinch" fence stay. With this stay the fence posts are spaced twice as far apart as would otherwise be necessary; three stays are then used between the posts, spaced at regular intervals. This results in the line wires being bonded together at one-half the distance as heretofore, with only one-half the number of posts required.

The three stays can be bought and put on the fence, it is claimed, for the cost of the labor required in digging the hole and "setting" the post which has been eliminated, and the use of the stays, therefore, adds no additional cost to the construction of the fence, and the result is a net saving of one-half of the fence post requirement.

Cinch stays offer many advantages over other materials intended for the same purpose inasmuch as they are made of double strand No. 10 hard galvanized wire and hence do not



Cinch Fence Stay.

rot off, burn up or rust. They are self locking and require no special tools or clamps to fasten them in place.

The fact that this stay has been adopted as a standard fencing material by many of the largest railroad systems in the country and has been used extensively by the United States government in connection with its reclamation projects, speaks well for its efficiency and merits. The Cinch stay is manufactured by the Worth Wire Works, Kokomo, Ind.

Personals

Although we are publishing monthly in these columns a practically complete report of all appointments of interest to our readers, it is probable that this information could be published earlier if each subscriber would make it his business to notify us of new appointments immediately. We request and we shall appreciate your assistance in this respect.

W. J. BRODGEN has been appointed roadmaster of the *Appalachian Northern R. R.* at Port St. Joe, Fla.

J. F. VANCE has been appointed roadmaster of the *Birmingham Southern R. R.*, office at Birmingham, Ala., succeeding H. J. WURTELE, promoted.

W. M. CARROLL, formerly at Humboldt, has been promoted to roadmaster of the *Canadian Northern Ry.* at Saskatoon, Sask., succeeding A. DRAPER. W. MCRAE has been appointed roadmaster at Humboldt, Sask., succeeding W. M. CARROLL.

N. BERGER has been appointed roadmaster of the Eastern division of the *Canadian Pacific Ry.* at Farnham, Que., succeeding O. KIRKLAND, transferred to Smiths Falls, Ont. J. HARP has been appointed roadmaster of the Saskatchewan division at Regina, Sask. R. C. MONTGOMERY has been appointed roadmaster of the Eastern division at Ottawa, Ont. J. WALSH, formerly at Farnham, Que., has been appointed roadmaster at Smiths Falls, Ont., Eastern division.

As announced previously in *RAILWAY ENGINEERING*, M. LONG has been appointed roadmaster of the *Canadian Pacific Ry.* at Kingston, S. D. He entered the service of this railway in 1885



J. F. VANCE, Roadmaster
Birmingham Southern Ry.

as section foreman, was promoted to yard foreman and later to construction foreman, which position he held at the time of his appointment as roadmaster.

A. W. HOLLAND has been appointed roadmaster of the *Caro Northern Ry.*, office at Caro, Tex., succeeding Wm. KERSEY.

J. M. FLANAGAN has been appointed roadmaster of the *Charleston & Western Carolina Ry.*, office at Fairfax, S. C., succeeding Y. H. BLANKENSHIP.

F. C. SINGLETON has been appointed supervisor of track of the *Chesapeake & Ohio Ry.* at Richmond, Va., succeeding I. H. LEITCH.

H. R. CLARK, formerly roadmaster at Aurora, Ill., has been appointed roadmaster of the *Chicago, Burlington & Quincy R. R.*, Burlington division, at Burlington, Ia. E. M. KEOUGH, formerly roadmaster, has been appointed roadmaster and assistant trainmaster at Aurora, Ill. GEO. MURPHY, who has been connected with this railroad for 23 years in the maintenance and bridge and buildings departments, has been appointed roadmaster at Aurora, Ill. R. C. VIOLETTE has been appointed roadmaster at Aurora, Ill., succeeding E. KEOUGH.

C. F. ALLEN has been appointed roadmaster of the *Chicago, Milwaukee & St. Paul Ry.* at Miles City, Mont. W. E. BROWN



M. LONG, Roadmaster
Canadian Pacific Ry.

has been appointed roadmaster at Lewiston, Mont. J. W. COURTNEY has been appointed roadmaster at Lewiston, Mont. J. GOULD has been appointed roadmaster at Great Falls, Mont. O. MILLER has been appointed roadmaster at Missoula, Mont. J. H. SHEAHAN has been appointed roadmaster at Saltese, Mont.

ROY JOHNSON has been appointed roadmaster of the *Chicago, Rock Island & Pacific Ry.* at Pratt, Kan., succeeding J. CLEMENTS, whose present address is Maple Hill, Kan.

G. W. ROUREK, supervisor of the *Cincinnati, Hamilton & Dayton Ry.*, has been transferred from Indianapolis to Connersville, Ind.

A. WINN has been appointed supervisor of track of the *Cincinnati, New Orleans & Texas Pacific Ry.* at Somerset, Ky.

L. B. ELLIOTT has been appointed supervisor of track of the *Cleveland, Cincinnati, Chicago & St. Louis Ry.* at Vienna, Ill. J. H. KEENAN has been appointed supervisor of track at Mt. Carmel, Ill.

T. W. BRAYSHAW has been appointed supervisor of the *Erie R. R.* at Marion, O., succeeding A. E. MONAHAN, now employed as an

HURLIHE, track supervisor at Willamantic, has been promoted to supervisor at Danbury, Conn., succeeding PATRICK KIELY.

G. M. DUGGER, who has been appointed roadmaster of *Morgan's Louisiana & Texas R. R.*, was employed as extra gang foreman by this road for three years. He was appointed assistant roadmaster of the Mississippi Terminal R. R. June 1, and roadmaster, as stated above, on September 1, 1913.

J. H. REDDING has been appointed supervisor of the *Northern Central Ry.* at Baltimore, Md., succeeding R. J. BOND.

M. DUFFY has been appointed roadmaster of the *Oregon-Washington R. R. & Navigation Co.* at Cosmopolis, Wash. A. L. OLSON has been appointed roadmaster at La Grande, Ore.

R. J. BOND has been appointed supervisor of the Manhattan division of the *Pennsylvania R. R.* at New York, N. Y. S. L. CHURCH has been appointed supervisor of the Monongahela division, office at Dravosburg, Pa. M. W. CLEMENT has been appointed supervisor of the Pittsburgh division at Conemaugh, Pa. R. S. STEWART has been appointed supervisor of the Trenton divi-



G. M. DUGGER, Roadmaster*
Morgan's Louisiana & Texas Ry.



C. J. FINNELLE, Assistant Roadmaster*
St. Louis South-Western Ry.

engineer at Cleveland, O. E. TRENHOLM has been appointed supervisor of track at Avon, N. Y., succeeding J. E. JACOBS.

O. T. NELSON, superintendent of maintenance of way of the *Atlanta & West Point R. R.* and the *Western Ry. of Alabama*, has had his jurisdiction extended over the *Georgia R. R.*, office remaining at Atlanta, Ga. WM. ROBINSON, Jr., has been appointed assistant engineer at Augusta, Ga.

R. CLAPP has been appointed assistant roadmaster of the *Great Northern Ry.* at Moorhead, Minn., succeeding J. NEWBERG.

S. C. GRIZZLE, roadmaster of the Taylor sub-division, has been appointed roadmaster of the *International & Great Northern R. R.* at Houston, Tex., succeeding J. E. TOBIN, resigned.

J. T. CHERRY has been appointed supervisor of the *Louisiana & Arkansas Ry.* at Minden, La., succeeding PAUL KAISER, who has been placed in charge of the yards at Hope, Ark. T. M. HUTSON, supervisor, has been transferred from Stamps, Ark., to Winnfield, La.

J. A. SIMMONS has been appointed roadmaster of the *Midland Valley R. R.* at Pawhuska, Okla. He succeeds A. MAHONEY, who has been placed in charge of one of the company's ditchers.

P. SLOAN has been appointed roadmaster of the *Missouri, Oklahoma & Gulf Ry. of Texas* at Dennison, Tex., succeeding V. GLEASON.

J. Y. DOLLAR, roadmaster of the *Missouri Pacific Ry.*, has been transferred from Beebe to Newport, Ark.

P. DARRIGAN has been appointed track supervisor of the *New York, New Haven & Hartford R. R.* at Middletown, Conn. P. J.

sion, office at Jamesburg, N. J. He succeeds C. E. WHITLOCK, who has been appointed supervisor in the general manager's office at Philadelphia, Pa. C. W. BARWIS has been appointed assistant supervisor of the Pittsburgh division at Gallitzin, Pa. J. B. MCWILLIAMS has been appointed assistant supervisor of the Elmira division at Elmira, N. Y., succeeding Mr. BARWIS.

CHAS. WATKINS has been appointed roadmaster of the *San Antonio & Aransas Pass Ry.* at Skidmore, Tex., succeeding M. E. MUNCEY.

E. J. BROWN has been appointed roadmaster of the *Union Pacific R. R.* at Omaha, Neb. J. H. BROWN, roadmaster at Kansas City, Mo., has been appointed roadmaster at Lawrence, Kan., succeeding CHRIS FEUCHE. C. F. HIDEMAN, roadmaster at Oakley, Kan., has been appointed roadmaster at Sterling, Colo. J. P. SCOTT has been appointed roadmaster at Oakley, Kan., succeeding Mr. HIDEMAN.

It is said that the Kansas City Terminal is building a second track extension two miles in length from Southwest boulevard to St. Louis avenue, Kansas City, Mo., and plans have been made to lay three miles of third and fourth tracks from Prospect avenue to Sheffield, and three-quarters of a mile of third and fourth tracks from Frisco to Broadway.

The Long Island is surveying double tracks to Montauk, L. I.

The Louisville & Nashville it is said will build a 30-mile extension of the Lexington & Eastern from McRoberts to Elkhorn City, Ky.

* Appointment noted in December issue.

With The Manufacturers

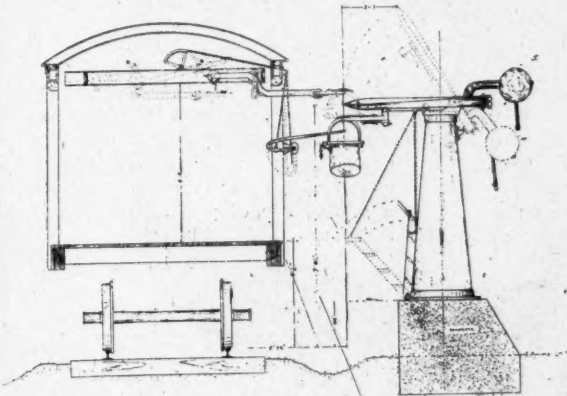
JONES MAIL CRANE.

A mail crane which both receives and delivers mail sacks from and to passing trains simultaneously is manufactured by the Universal Mail Dispatcher Co., Los Angeles, Cal., under the name "Jones Mail Dispatcher." The post office department of the government is engaged in testing the device for purposes of comparison with others in use.

The device as installed on the Southern Pacific is illustrated in the drawing and photograph reproduction herewith. It consists of a standard or crane at the station, with a pair of horns set in a cradle, placed on the top of this standard, the horns making a circle on the side towards the railroad track, the points of the horns extending or lapping over for three or four feet; the ends of the horns, or fingers, pointing one up and the other down the track.

These horns have a break or joint in them some four feet from the tip. Below the horns, attached to the standard, pointing towards the track, is a delivery arm.

Inside the car itself, a track is run along the roof, over the center of the door, from one side of the car to the other. In



Section, Jones' Mail Crane.

this track is a steel carriage on wheels, with a delivery arm at either end. This is attached to a catcher hook, which is fixed on the forward side of the door of the car.

In operation the mail sack is fastened to a steel ring. This ring is placed in a slot at the end of the delivery arm on the standard, the horns and delivery arm at this time being horizontal. One of the fingers of the horns is then folded, leaving the other one pointed out in the direction from which the train is coming.

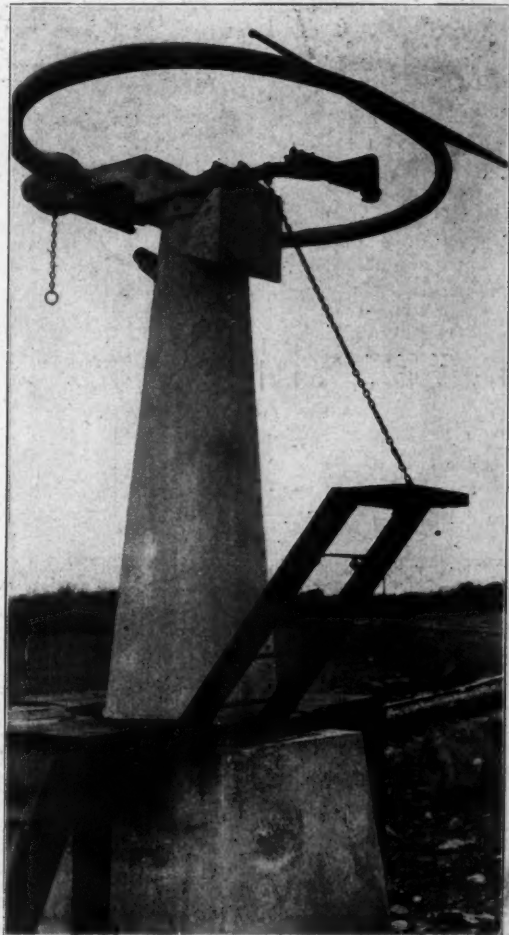
On the car, the mail man attaches the mail bag (to be delivered) to a similar ring and puts this ring onto the delivery arm in the car. At the time that he approaches the station, he pushes the arm along the track in the car, out of the door. This latches in the door, and retains the delivery arm, with the bag suspended out of the door, in the proper position, the catcher hook having been set at the same time by the operation.

As the train approaches the standard the point on the catcher hook passes through the ring, to which is attached the bag suspended on the delivery arm at the standard, taking the bag from the standard, the hook being of such shape that the ring passes along the hook and whirls into the car.

The horn on the standard, in the meantime, has passed through the ring which was hanging from the delivery arm on the car and taken the ring from this delivery arm. The ring with the bag attached swings around the horn and stops when it reaches the standard. The weight of the bag, going around the horn, is sufficient to cause the horns to bend back

and assume a position of about 45 degrees, thus making a clearance on the track absolutely safe.

This is the simple operation of the device, and in this way the mail bags are hung up without possible damage to themselves or to any person, and the mail is put inside the car in



Jones' Mail Crane Ready for Sacks.

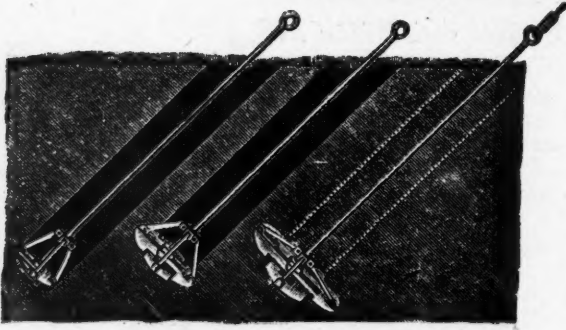
an equally safe manner. The rings are so arranged that they can be quickly unfastened from the catcher hook and from the horns on the standard.

The device has been tested for two or three years, and has demonstrated its ability to handle all kinds of mail at high rates of speed, as well as at lower rates of speed, say five to sixty miles per hour.

On some of these trips, at as many as ten or twelve stations, it has delivered at each station mail aggregating from 200 to 450 pounds, at speeds varying from 25 to 55 miles an hour, and collected into the car mail at each delivery.

"EVERSTICK" ANCHOR.

An anchor for guying work and for other purposes which require permanent anchorage of great resistance, is shown in the accompanying illustration. This anchor requires a hole of comparatively small diameter bored at the proper angle. The device is then inserted while closed. A special tamping bar is then used to



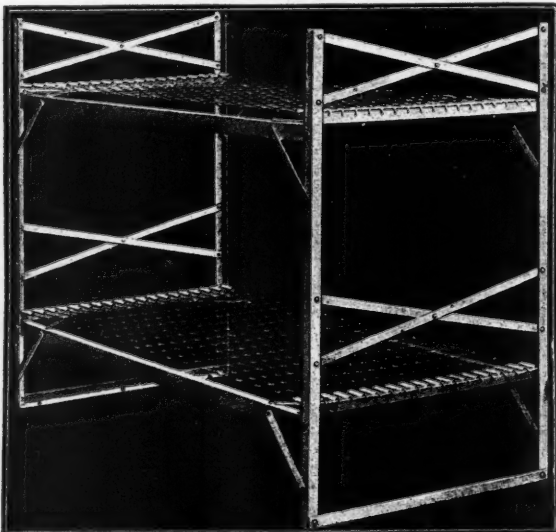
Everstick Anchor in Closed, Partially Expanded, and Open Positions.

force open the blades at the bottom of the hole which is then filled up.

The anchors are made in several different sizes according to the load they are expected to hold and are also made with two or four blades. They have been adopted after successful tests by a great many power companies, telephone and telegraph companies and other concerns maintaining pole lines.

SANITATION IN SLEEPING QUARTERS AS A FACTOR IN SECURING AND HOLDING AN ACCEPTABLE CLASS OF TRACK LABORERS.

At the annual meeting of the Roadmasters' Association, held in Chicago in September, the subject of sanitary sleeping quarters for track workmen was discussed, and resulted in the following report by the committee: "We believe a perfect solu-



Calumet Steel Co.'s Steel Bunk.

tion of this problem has been found in the all steel bunk, which has just been put on the market, and which cannot help but appeal to every one who has had the proper housing of men to contend with. These bunks are strong, thoroughly braced, double or single deck, coated with a rust-proof enamel, and apparently fill a long felt want. We recommend their use."

The "Calumet" steel bunks, illustrated herewith, which are being made and sold by the Calumet Supply Mfg. Co., 900 So. Michigan Ave., Chicago, fulfill every requirement of strength, durability and cleanliness, and have the added advantage of being very low-priced. The standard size of double deck runs 5 ft. high, 6 ft. 6 in. long, and 2 ft. 6 in. wide; distance between springs 36 in. Special sizes may easily be made to order.

Industrial Notes

The Light Inspection Car Company, of Hagerstown, Ind., has reorganized under the name of the Teeter-Hartley Motor Co. The management will remain the same.

The outlook in the steel trade is more promising though actual orderings are light. Railroads are still purchasing in small volume but are making preparations for buying track material on a large scale.

The new plant of the American Steel and Wire Company at Fairfield, Ala., near Birmingham, will be put in operation shortly after the first of January.

F. E. Yeager, until recently chief clerk to the engineer of maintenance of way of the Chicago Great Western, has severed his connection with that road to engage in the railway supply business. His company will be known as the Specialty Sales Co., with offices in the Railway Supply Permanent Exhibit, Karpen building, Chicago. This company has taken the exclusive sales agency of the Turner hot blast tubular torch for cleaning snow and ice from frogs, switches, guard rails, etc., and would like to add to their present line of track specialties.

The Railroad Water & Coal Handling Co. has been formed, with offices at 537 South Dearborn street, Chicago. The officers are: M. D. Miller, president; T. S. Leake, vice-president, and W. F. Leake, secretary and treasurer. Each of the officers has had a large amount of railroad experience, Mr. Miller having had twenty-six years' experience in railroad water service; T. S. Leake thirty-three years' experience with buildings and coal chutes, and W. F. Leake twenty-two years' experience with buildings. The firm will construct water and coaling stations, make investigations concerning water supply, design treating plants and handle a general line of pipe and fittings, water tanks, gas engines and pumps.

New Literature

C. H. & E. Buzzer is the title of a 1914 booklet of portable buzz saws. Attractive detail illustrations are shown of two types of buzz saws, together with illustrations of the same machine at work on different jobs. This booklet contains some live information and is of value to anyone using or needing one of these machines. The back page of the pamphlet shows small illustrations and gives a list of a large number of hoists, mixers, pumps, saw jigs, etc., manufactured by the C. H. & E. Manufacturing Company, Milwaukee, Wis.

An odd but attractive leaflet is issued by the Southern Railway Supply Company, St. Louis, Mo., devoted to the Saunders Car Stopper. A complete exposition of the theory and practical application of this device is given, together with a number of illustrations of the large number in service. The unique feature of this car stopper is provision for gradual stopping of the car by the wheels engaging a series of corrugations of graduated increasing size.

The Union Switch & Signal Company, Swissvale, Pa., has issued Bulletin 67 describing style D. C. and A. C. top post signal mechanism. The illustrations and typography of the book are equal to that of previous printed matter of the company.

The Chicago Pneumatic Tool Company, Fisher Building, Chicago, recently issued Bulletin 34-D, devoted to the horizontal cross compound Corliss compressor. The principal features of Chicago Pneumatic Corliss steam driven compressors of standard design are presented, for capacities of 1,000 to 6,000 feet per minute, and for all usual air or steam pressure, condensing or noncondensing. The book is illustrated with a large number of diagrams which help explain the text in a very clear manner.

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